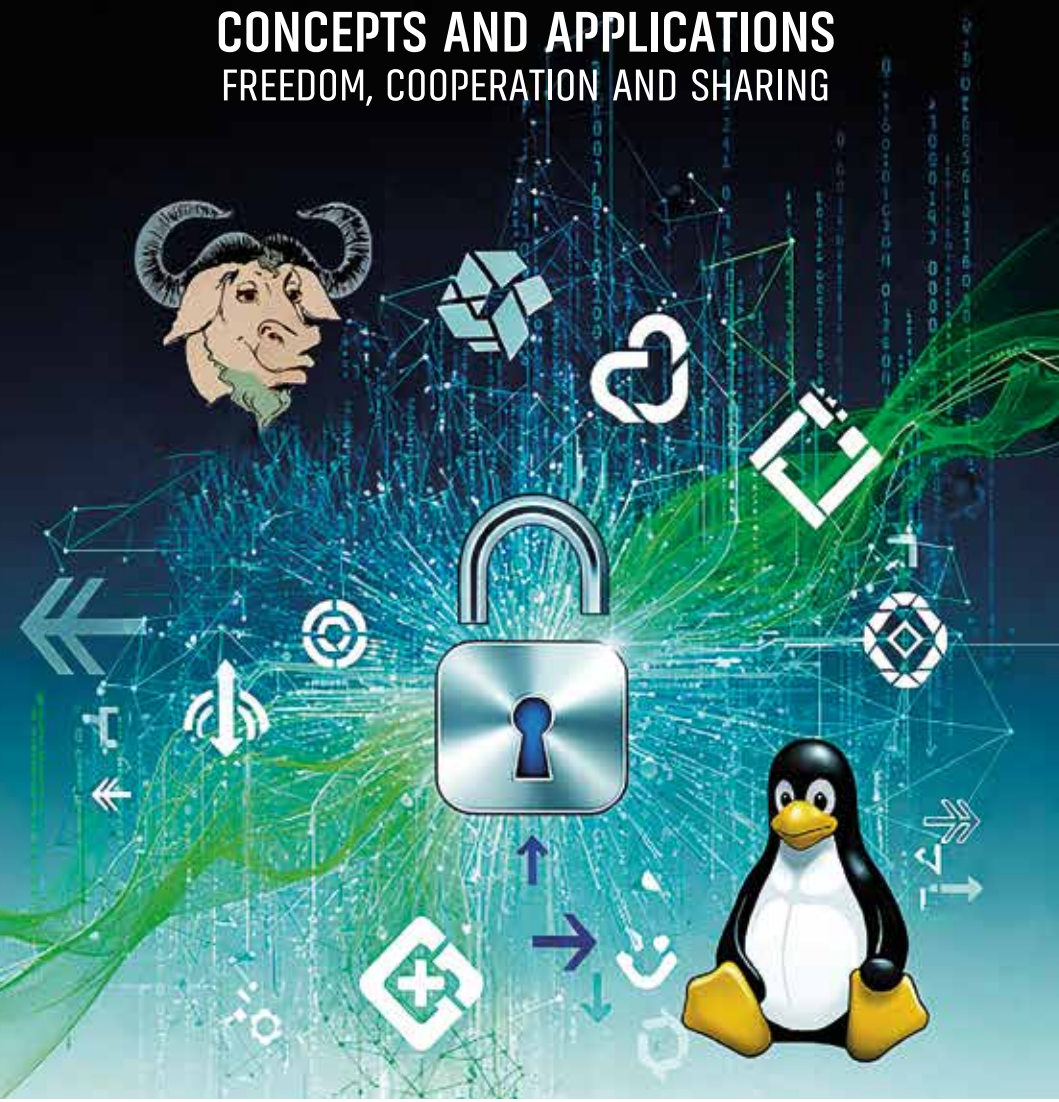
FREE SOFTWARE PHILOSOPHY

CONCEPTS AND APPLICATIONS

FREEDOM, COOPERATION AND SHARING



Dr. B. Ekbal

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Concepts and Applications
Freedom, Cooperation and Sharing

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CHINTHA PUBLISHERS
Thiruvananthapuram

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Dr. B. Ekbal

Retired Professor of Neurosurgery • Former Vice Chancellor, University of Kerala • Former Member, Kerala State Planning Board

Dr. B. Ekbal is a neurosurgeon, public health advocate, and educationalist who has played a pivotal role in shaping Kerala's health and academic landscape over the past four decades. He served as the Vice-Chancellor of the University of Kerala (2000–2004), where he led major academic reforms and modernisation initiatives.

A leading figure in India's public health movement and a neurosurgeon, Dr. Ekbal has held several influential positions, including Professor and Head, Department of Neurosurgery, Kottayam Medical College; National Convenor, Jan Swasthya Abhiyan (People's Health Movement–India); President, Kerala Sastra Sahitya Parishad (KSSP), Member, Kerala State Planning Board; and Project Board Chairperson of National Institute of Speech and Hearing (NISH). He has also served as Chairperson of the Kerala State Pollution Control Board, the Kerala State Health Policy Committee, the committee to draft the project report for establishing a Medical University in Kerala, the Kerala State COVID-19 Expert Committee, and the Kerala Vaccine Policy Committee.

A prolific writer and public intellectual, Dr. Ekbal has authored numerous books and articles in both Malayalam and English on health policy, science, education, social development, and literature. His work spans scholarly research, public communication, and activism, reflecting a lifelong commitment to scientific temper, social justice, and public health equity.

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DEDICATION

Dedicated to

Aaron Swartz

November 8, 1986 – January 11, 2013

who tirelessly championed the freedom of knowledge and, succumbing to the pressures of injustice, sacrificed his life amid severe mental anguish .

PREFACE

The debate surrounding the restrictive impact of patent regulations on the pharmaceutical sector, a domain intrinsically linked to human health and survival, has dominated international and Indian policy discussions since the early 1980s. This was a critical issue for health activists in India, who rightly championed the nation's independence in drug production, secured by the landmark Indian Patents Act of 1972. It was through my involvement in the health movement, actively campaigning for the global necessity of high-quality, low-cost essential medicines, that I first encountered the profound ethical conflict posed by monopolistic intellectual property (IP) laws.

This landscape reached a crisis point in January 2005 when India complied with the World Trade Organisation's TRIPS (Trade-Related Aspects of Intellectual Property Rights) agreement. The immediate consequence was a sharp surge in the prices of life-saving medicines, plunging the sector into prolonged distress. It was precisely against this backdrop of campaigning against profit-driven monopolization that I discovered the foundational work of Richard Matthew Stallman. Stallman's Free Software philosophy, grounded in the principles of freedom, cooperation, and sharing, offered a powerful ethical and structural alternative to restrictive IP regimes. This philosophy, initially applied to computer code, seemed to offer the same moral solution

that health activists were seeking for essential drugs. Subsequent thinkers, such as Lawrence Lessig and others, further expanded this concept beyond software, driving the core arguments of this book.

The philosophy of Free Software occupies a critical position in the social and technological advancement of Kerala. During my tenure as the Vice-Chancellor of Kerala University, Richard Matthew Stallman accepted our invitation to deliver the inaugural E.M.S. Commemoration Lecture in July 2001. His presence proved instrumental in broadly popularizing the Free Software concept across the state. I was also privileged to serve as the President of the Democratic Alliance for Knowledge Freedom (DAKF), an organisation founded on March 19, 2011, with the aims of securing the freedom of knowledge, expanding the use of Free Software, eliminating technological inequality, and ensuring the welfare of workers in knowledge industries. During the COVID-19 pandemic, this ethos extended globally, as I was able to liaise with the Open-Source Pharma Foundation, which championed the cooperative production of medicines and diagnostic tools.

I had long realized that documenting the repercussions and ethical resonance that the Free Software philosophy is generating across various scientific, technological, and intellectual domains was a necessity of our time. This book is a modest effort stemming from that profound realization. Acknowledging that I am not a specialized expert in computer or intellectual property law, I completed this book with the invaluable intellectual support of several prominent colleagues active in this domain. I hereby sincerely acknowledge and express my heartfelt gratitude to: Dr. Sunil T.T. (Director, ICFOSS), Dr. U.C.A. Jaleel (Principal Scientist, NIAS, IISc), Dr. Athira P.S. (Director, C-IPR, NUALS), Dr. R. S. Praveen Raj (Senior Principal Scientist, NIIST), Dr. Achuthsankar S. Nair (Former Professor and Head, Computational Biology, Kerala University), and Gopakumar K.M. (Legal Advisor, Third World Network).

I humbly dedicate this work to the proponents of the Free Software philosophy and submit it to the wider community for critical reading and engagement. I extend my profound gratitude to Chintha Publications for their invaluable support in bringing this book to fruition.

January 1, 2026
Thiruvananthapuram

Dr. B. Ekbal

CONTENTS

Preface		vii
Publishers Note		xi
Chapter 1	Intellectual Property Rights and the Free Software Philosophy	1
Chapter 2	The Detrimental Consequences of Intellectual Property Rights	13
Chapter 3	International Trade Agreements and Intellectual Property Rights	25
Chapter 4	The Origin of the Free Software Concept	37
Chapter 5	Creative Commons: The Creative Expansion of the Free Software Philosophy	47
Chapter 6	Free Software and Open-Source Software	55
Chapter 7	Open Access Publications: Gateways to Knowledge	65
Chapter 8	Wikipedia: The Free Collaborative Encyclopaedia	87
Chapter 9	Open Science: The Democratization of Scientific Knowledge	99
Chapter 10	Open-Source Drug Discovery: A Collaborative Movement in Pharmaceutical Research	111
Chapter 11	Open-Source Hardware: Freedom in the Physical World	127
Chapter 12	OpenStreetMap: The Open Map of Knowledge	133
Chapter 13	Free Software and Open-Source Movements	139
Chapter 14	Free Software, Open-Source, and Artificial Intelligence: The Roots of Future Technology	145
Acronyms		155
References		159
Index		163

PUBLISHER'S NOTE

"The commons is a subject almost impossible to hold in mind without remarking on its diminution and destruction. We cannot but think of the commons without observing how much they have receded, from the Early Modern period to the present day, as a result of one or other form of 'enclosure' upon them."

Akeel Bilgrami

This book examines the historical evolution of intellectual property rights and the accompanying intellectual commons from the 15th to the 21st century. The author's primary concern is the immense speed and scale of privatization in the social sphere, particularly in the current era characterized by rapid technological developments and globalization. The book meticulously analyses the process of "enclosure" of resources and knowledge that once belonged to everyone, examining how it is affecting the development of technology and the spread of social knowledge, and what the consequences of this are for the future.

The author argues that all human beings and all creations are a dense cluster of social interactions. The book introduces the concept of

"Intellectual Commons" as a space where human knowledge, culture, and achievements belong collectively to everyone, and discusses the conflicts faced by this "commons" due to the excessive protection of intellectual property rights. This concept is explored through a detailed examination of scientific discoveries, literature, music, and software.

The modern age has seen a fierce battle between two opposing forces: the desire for intellectual property rights (such as patents and copyrights), which encourage innovation by granting exclusive ownership, and the need for the intellectual commons, which fosters social knowledge creation and public welfare. The book aims to initiate a deep discussion on the future of this struggle and how to balance the demands of creators/innovators with the rights of the public.

This book is sure to spark a significant intellectual debate on the right to knowledge and the future of scientific development.

Chintha Publishers

CHAPTER ONE

Intellectual Property Rights and the Free Software Philosophy

Free Software is not merely a technical collection of computer codes; rather, it is a philosophical approach that challenges traditional notions of intellectual property rights and proposes a new model for the sharing of knowledge and creativity.

Before delving into the Free Software concept, it is necessary to explain the fundamental principles of intellectual property rights and the laws governing them.

What are Intellectual Property Rights?

Intellectual property includes inventions, writings, songs, pictures, designs, business names, symbols, and images that are newly created from human intellect (mind). Intellectual Property Rights (IPR) are conceived to legally determine and protect the ownership of these creations. IPRs are the rights legally granted to the owners of such creations, allowing them to maintain a monopoly over them for a specified period and generate income from them.

Objectives of Intellectual Property Rights

Intellectual Property Rights operate with the twin goals of encouraging people to discover new things while making knowledge and new ideas available to the public. The main objectives of IPR are as follows:

- **Promoting New Inventions and Artistic Creations:** This is the most important objective of IPR. By granting exclusive rights over creation, individuals, researchers, and companies are encouraged to develop new ideas, technologies, and artistic works. They are motivated to make more inventions, knowing that their creations will be protected and they can earn income from them.
- **Protecting Creators:** IPR protects the moral and economic rights of creators. This helps prevent others from using or misusing their creations without permission.
- **Supporting Economic Growth:** By encouraging research and new discoveries, IPR attracts domestic and foreign investment, stimulating commercial activities. IPR enables companies to establish brand identity, differentiate their products from others, and compete fairly. This significantly contributes to the country's economic growth.
- **Encouraging Knowledge Sharing:** According to IPR laws, it is a key responsibility of the inventor to disclose the details of an invention to the relevant agencies. When special rights, such as patents, are granted, this disclosure is mandatory, aiming to make all information about the invention publicly available. By publicizing this information, others are encouraged to expand the common knowledge base, study new subjects, and make further inventions based on that foundation. In short, while IPR provides special protection to the inventor, it also helps make knowledge available to the public, thereby stimulating further research and development.
- **Ensuring Fair Competition:** By protecting new inventions and brands, IPR helps curb harmful practices such as piracy, enabling companies to compete based on the quality and originality of their own creations.
- **Protecting Cultural Heritage and Identity:** IPR laws, such as **Geographical Indications (GI)**, protect products associated with specific regions. This helps safeguard unique knowledge, local art forms, and cultural heritage, often securing economic benefits for local communities.
- **Ensuring Consumer Trust and Safety:** Trademarks and other recognitions help consumers identify genuine, quality products.

This builds market trust and protects consumers from counterfeit products that are substandard or harmful.

Fundamental Principles of Intellectual Property Rights

Behind the objectives of IPR lie certain fundamental principles that determine how these rights operate:

- **Exclusivity and Ownership:** The owner of an intellectual creation is granted the exclusive rights to use, copy, distribute, display, perform, and commercially exploit it for a fixed period. This exclusivity is the foundation of intellectual property protection.
- **Time-Limited Protection:** Intellectual Property Rights are not perpetual; they have a defined lifespan. Once this period expires, the creation becomes available for public use and sharing. This ensures creators are compensated while preventing indefinite monopolies that could hinder future innovation.
- **Territoriality:** IPRs are typically specific to a particular country. The right obtained in one country is legally enforceable only within that country's borders. Protection can be sought separately for products in each country.
- **Balance of Interests between Creators and the Public:** The core of IPR is to harmonize the interests of the creator and the public. One part involves supporting artists, scientists, and inventors by providing protection and encouragement for new creations. The other essential part is making this knowledge and these inventions available to everyone and using them to promote the overall growth of society. Legal provisions like 'Fair Use' or 'Exceptions and Limitations' help maintain this balance. For example, these laws permit limited use of a work for educational or research purposes. This ensures the dissemination of knowledge and public benefit while respecting the creator's rights.
- **Promoting Public Welfare:** Although IPR provides personal gains to creators, its goal is the overall progress and welfare of society. By encouraging innovation and mandating knowledge sharing, IPR systems contribute to technological, cultural, and economic advancement.
- **Novelty, Originality, and Inventiveness:** For forms of intellectual property like Patents, the creation has **Novelty**, **Non-Obviousness**, and demonstrates **Inventiveness**. This invention

must involve a creative or innovative step that is not easily apparent to someone skilled in that field, and it must be capable of **Industrial Application**. Copyright requires originality, meaning the work must be self-created and not copied. These criteria ensure that protection is granted only for genuine intellectual contributions.

- **Transferability and Licensing:** Like physical property, Intellectual Property Rights can be transferred (sold) or licenced to others. This enables creators to earn income from their works and facilitates the dissemination of technology and artistic works through various commercial agreements.

Understanding these objectives and principles is essential to grasping the legal and philosophical foundation of Intellectual Property Rights. When entering the world of Free Software, we must examine how these legal concepts are interpreted, the social challenges they pose, and the relevance of a new mindset that prioritizes freedom and collaboration.

Different Types of Intellectual Property Rights

Intellectual Property Rights are categorized into several types, with each category protecting different aspects of an intellectual creation. Understanding these distinctions is crucial for comprehending how Free Software licences operate.

Copyright:

- **What it Protects:** It protects literary, dramatic, musical, and artistic works. This includes books, articles, musical compositions, pictures, sculptures, films, architectural designs, and, very importantly for our study, computer programes (Source Code and Object Code).
- **How it Works:** Copyright protection is automatically granted to an original work upon its fixation in a physical form (e.g., writing a book or saving a file on a computer). Registration is generally not required for protection, but registering can be helpful for legal proceedings.
- **Rights Granted:** The copyright owner has the exclusive rights to reproduce, distribute, display, perform, and create new works derived from the original creation. These rights can be licenced or transferred to another party.

- **Duration:** Typically, the lifetime of the creator plus 50 or 70 years (varies by country's law).
- **Relationship with Free Software:** Free Software licences are most closely related to copyright. Free Software licences are essentially copyright licences. They grant users specific permissions, the Four Freedoms of "use, study, modify, and share" are not available under conventional copyright law.

Patents:

- **What it Protects:** It protects new and useful inventions, processes, machines, articles of manufacture, compounds, or new and useful improvements thereof, including pharmaceuticals. Software-related inventions that meet certain criteria are also sometimes included.
- **How it Works:** A patent is granted after the relevant government office examines that the invention is new, non-obvious, and capable of industrial application. The invention must be disclosed to the Patent Office with all its details, which will be made publicly available after the patent term expires.
- **Rights Granted:** The patent owner is given the exclusive right to prevent others from making, using, selling, or importing the patented invention for a fixed period.
- **Duration:** Typically, 20 years from the date of application.
- **Relationship with Free Software:** Software patents often cause significant controversy within the Free Software community. This is because patents can restrict the development and distribution of the source code, even if the software is freely licenced. Patent claims are likely to encompass algorithms or functions essential to Free Software, creating various challenges and legal problems.

Trademarks:

- **What it Protects:** It protects symbols, words, phrases, designs, or a combination thereof used to identify and distinguish a company's products or services from those of others. Examples include the Google logo, the name "iPhone," various product names, and slogans.
- **How it Works:** Rights are obtained through use in commerce or by registering with a government Trademark Office.

- **Rights Granted:** The owner gains the exclusive right to use the mark in relation to the registered products or services. This prevents confusion among consumers.
- **Duration:** Typically, ten years. It can usually be renewed indefinitely as long as the mark remains in use.
- **Relationship with Free Software:** Free Software projects and organisations use trademarks to protect their brand identity (e.g., "Linux," "Firefox," "Debian"). This helps users distinguish genuine, official versions from modified or unofficial ones, which is critical for maintaining quality and trust.

Trade Secrets:

- **What it Protects:** Confidential information that gives a business a competitive edge over others. This can include formulas, methods, designs, instruments, patterns, compilations of information, or processes that are not generally known or easily discoverable. Examples include the Coca-Cola formula and certain special algorithms.
- **How it Works:** Protection is gained by keeping the information secret and taking necessary steps to maintain its confidentiality. Registration is not required.
- **Rights Granted:** The right to take legal action against those who misuse the secret (e.g., steal or wrongfully disclose it).
- **Duration:** As long as the information remains secret and provides a competitive advantage.
- **Relationship with Free Software:** Trade secrets fundamentally contradict the principles of Free Software. Free Software emphasizes the transparency of the source code and the freedom for everyone to use, share, and modify it. Free Software projects openly oppose the secrecy of software functionalities.

Industrial Designs:

(Design Patents in some countries)

- **What it Protects:** It protects the aesthetic, ornamental, and visual aspects of a product rather than its functional features. This includes the shape, configuration, pattern, or ornamentation applied to an article.
- **How it Works:** Registration is usually required.

- **Rights Granted:** The exclusive right to prevent unauthorized copies or imitations of the design.
- **Duration:** Varies by country, typically ranging from 10 to 25 years.
- **Relationship with Free Software:** It does not directly relate to software code. However, this may be applicable to the visual design of a User Interface (UI), provided that the design is novel and aesthetically pleasing.

Geographical Indications:

- **What it Protects:** It protects signs used on products that originate from a specific geographical location and possess qualities or a reputation associated with that place. Examples include "Champagne" from France, "Darjeeling Tea", and Basmati rice from India.
- **How it Works:** Usually registered collectively by an association of producers.
- **Rights Granted:** Prevents the use of the indication without authorization on products that are not from the specified area or that do not meet the specified quality standards.
- **Duration:** The product can be maintained indefinitely if it meets the specified criteria.
- **Relationship with Free Software:** Not directly applicable to software, as it lacks a geographical connection.

Sui Generis: Special Type of Intellectual Property Protection:

- **Meaning:** The Latin term *"Sui Generis"* in IPR laws means "*of its own kind*" or "*unique*".
- **Concept:** It refers to providing specific legal protection for intellectual creations and inventions that do not fall precisely within the scope of conventional IPR laws, such as patents, copyrights, and trademarks.
- **Purpose:** The *Sui Generis* system is used to create a suitable legal framework for specialized subjects, such as Traditional Knowledge (TK), where existing IPR systems fail to provide adequate protection. A special legal system is needed because Traditional Knowledge, which is collectively owned by communities and

passed down through generations, does not align with the traditional IPR laws based on individual ownership.

These two philosophies adopt different stances regarding the sharing and protection of knowledge.

Similarities and Differences between Free Software and Sui Generis Approaches		
Primary Goal	To regulate the use of traditional knowledge, prevent misuse, and protect cultural heritage.	To maximize the sharing of knowledge and grant freedom for technological innovation.
Ownership	Knowledge ownership is communal, belonging to a specific community or ethnic group.	Technical knowledge is shared by the individual or the community, and it is entirely free to use.
Scope	Confined only to the social groups possessing traditional knowledge.	The community is global and includes anyone, without limitations.
Control Approach	Imposes restrictions on sharing (Protection is the main goal).	Promote sharing (Freedom is the main goal).

Sui Generis laws and the Free Software philosophy share a fundamental unity in challenging the unilateral nature of Intellectual Property Rights. While one aims for the regulated use and protection of knowledge, the other promotes the maximum sharing and collaboration of knowledge. Sui Generis protection is an approach intended to safeguard its cultural and geographical context, whereas Free Software is a broad, freedom-oriented approach for individual and global knowledge sharing. It is impossible to contain various types of knowledge and the standards required for their sharing and protection within a single framework. Nevertheless, considering both sui-generis protection and the Free Software philosophy together can lead us toward a more consensual and democratic perspective on intellectual property issues.

Understanding the various forms of intellectual property rights provides a strong foundation for comprehending how Free Software philosophy challenges and adapts to existing legal structures, and how it utilizes these laws to achieve its unique goals of Freedom, Cooperation, and Sharing. The discussion of Intellectual Property Rights provides the conceptual foundation for understanding the emergence of Free Software.

NOTES

A Brief History of Intellectual Property Rights

The history of Intellectual Property Rights (IPR) is intrinsically linked to humanity's creative and inventive growth. The initial forms of protecting the ownership of a new idea, invention, or artistic creation have existed since ancient times. However, an official framework for such protection emerged with the invention of the printing press. As printing became widespread in the 15th century, it became necessary to control the copying of books. This paved the way for the early forms of modern copyright laws. Milestones in the evolution of copyright laws include the 1474 law in Venice, granting publishers the right to copy books, and the 'Statute of Anne' enacted in Britain in 1710. Patents for inventions also began to develop during this period.

The Industrial Revolution of the 18th and 19th centuries led to an influx of inventions and new products. This necessitated stronger legal protection for industrial patents and trademarks, helping to ensure the originality and distinctiveness of products and brands. As trade globalized, the need for mutual recognition of IPR laws across countries increased.

This led to international efforts to coordinate Intellectual Property Rights. Key among these was the Paris Convention for the Protection of Industrial Property (1883), which encouraged countries to protect patents, trademarks, and industrial designs. Later, the Berne Convention for the Protection of Literary and Artistic Works (1886) was established. These treaties laid the foundation for global IPR standardization. The World Intellectual Property Organisation (WIPO), established in 1967 and headquartered in Geneva,

Switzerland, emerged as the central institution promoting and protecting intellectual property worldwide.

The rapid technological growth of the 20th century, particularly the rise of information technology and the digital revolution, presented new challenges and opportunities for IPR laws. The protection of software, databases, and digital content became increasingly complex. In this context, the formation of the World Trade Organisation (WTO) marked a decisive phase in the history of IPR. The TRIPS Agreement (Trade-Related Aspects of Intellectual Property Rights), which came into effect in 1995, established comprehensive and enforceable international standards for intellectual property protection. TRIPS covers patents, copyrights, trademarks, geographical indications, industrial designs, and layout designs of integrated circuits, creating a unified global framework for IPR.

Today, Intellectual Property Rights are an integral part of the global economy. They encourage innovation and creativity, protect investments, and ensure fair commerce. Yet, contemporary challenges, including digital piracy, cybercrimes, genetic patents, and the rise of Artificial Intelligence, demand continuous reform and re-evaluation of existing laws. The enduring challenge before policymakers and jurists is to maintain a fair balance between incentivizing innovation and ensuring public access to knowledge and creativity, a balance that defines the moral and legal core of IPR in the 21st century.

Source Code

A computer programe is a set of instructions that a computer follows to perform specific tasks. The Source Code is the version of a programme written in a human-readable form by programers, using programmeming languages such as Python, Java, or C++. It represents the software's logical structure and functional intent. In essence, it serves as the "recipe," "blueprint," or "manufacturing plan" that defines how a programme should operate. In Free Software, this Source Code is made publicly accessible, allowing anyone to study, modify, and distribute it.

Object Code and Machine Code

Object Code (or Machine Code) is the version of a programme that a computer can directly read and execute. The Source Code written by a programer cannot be understood by the computer's processor, as it

only interprets binary instructions, a sequence of '0's and '1's known as Machine Language. Therefore, the Source Code must be converted into this binary form using special programmes such as Compilers or Interpreters.

Once converted, the programme becomes executable, meaning the computer can perform the tasks described in the original Source Code. In simple terms, every application running on a computer operates internally using Machine Code, even though it was originally written by humans in Source Code form.

CHAPTER TWO

The Detrimental Consequences of Intellectual Property Rights

Although Intellectual Property Rights (IPR) laws were designed with the noble goal of encouraging new inventions and artistic creations, they carry several complex and detrimental consequences. The adverse aspects of these laws, such as how they obstruct the free flow of knowledge and technology, the challenges they pose to the public health sector, their limitations on universal accessibility of knowledge, and their conflict with the Free Software philosophy, have become critical subjects in contemporary discussions.

Public Research, Private Patents: The Appropriation of Knowledge

Public research institutions, universities, and scientists play a crucial role in developing new technologies and products. However, large corporations often appropriate the patents or licences for the resulting products and market them for profit. Often, the research outcome is known by the company's name, rather than that of the institutions or scientists who conducted the research.

For example, fundamental medical research funded by the public and carried out by institutions such as the National Institutes of Health

in the United States often yields numerous significant discoveries. However, in the case of pharmaceuticals, there is a persistent tendency for private drug companies to acquire patent rights over these research findings. These companies claim patents and licences by asserting that they provide funding for human clinical trials and that they manufacture and market the drug. As a result, the public is ultimately forced to pay high prices for technologies originally discovered using their own tax money.

Oncomouse, the transgenic non-human mammal whose DNA was intentionally altered by scientists Philip Leder and Timothy A. Stewart at Harvard University to include an activated human oncogene, which can promote the formation of tumors. This modification ensures the mouse develops cancer at a much higher rate than a normal mouse. The OncoMouse was designed to serve as a standardized biological model for cancer research. By studying how tumors develop in mice and how they respond to new drugs or therapies, scientists can gain crucial insights into human cancers. The patent for this research, conducted at Harvard University in the early 1980s, belonged to the university, but DuPont acquired the licence for production and sale in April 1988. The original researcher's name was forgotten, and the hybrid mouse was known as the 'DuPont Mouse'. Similarly, the Polymerase Chain Reaction (PCR), an advanced diagnostic technology now widely used for diagnosis and viral identification, was invented by Nobel laureate Kary Banks Mullis. Although he made this critical discovery in 1983, the patent was acquired by the Cetus Corporation. The private company's ownership of the patent for this foundational technology of PCR tests imposed a significant financial burden on the public and government healthcare systems.

Monopolies and Exorbitant Prices

Intellectual Property Rights, particularly patents, grant inventors complete control over their products for a specific period. This often leads to the granting of mandated monopoly rights. In effect, a patent is a government-granted monopoly privilege granted to the patent holder. This provides patent holders with legal protection to charge very high prices for their products and technologies during that fixed term. Since no one else is legally permitted to manufacture the product, there is no significant price competition. This creates an unbearable financial burden for the common person in critical sectors,

such as lifesaving medicines, and raises major ethical issues within the healthcare sector.

Copyrights can hinder the free flow of information and ideas, slowing scientific research and the development of new inventions. Researchers may hesitate to share their findings due to concerns about infringing existing patents, thereby hindering open collaboration. In some industries, a product or technology may be surrounded by numerous patents. This type of Patent Thicket makes it extremely difficult and costly for newcomers to invent or manufacture existing products, thereby eliminating healthy competition and progress.

The act of acquiring extremely broad patent rights that encompass the basic idea or underlying technology of an invention, along with all its potential future variations and uses, is known as Umbrella Patenting. This provides legal protection for many variations of new technology under a single umbrella. Instead of protecting new inventions, this practice is likely to hinder further research and development in that field.

Hinders New Inventions and Creations

Overly stringent and excessive IPR laws can often hinder, rather than encourage, the development of new inventions. It becomes a major challenge for individuals and companies to develop new ideas from existing ones or make even minor improvements to existing products. If every component of a product and its associated ideas are patented, it becomes a legal quagmire for anyone attempting to develop a new product. Fearing patent infringement, researchers and entrepreneurs are often forced to abandon their ideas or engage in long, complex legal battles. This significantly slows society's technological and intellectual progress.

The vast patent collections held by large corporations often pose a major threat to small inventors and startups. One such threat is the lawsuits filed by large companies alleging infringement. These cases are extremely expensive and time-consuming. Because they lack the financial resources for a legal battle, this fear can deter small businesses and startups from entering new markets or pursuing their inventions. This effectively kills competition and suppresses innovation.

The practice of making minor, often insignificant, changes to a currently patented product and applying for a new patent just before the original one expires is known by several names, including Evergreening,

Frivolous Patenting, or Perpetual Patenting. This is essentially an attempt to artificially and indefinitely prolong the patent term. In the case of medicines that offer no significant therapeutic advantage, slight modifications are made to the chemical structure used to produce them to obtain a new patent. These are then claimed as "innovative" and marketed at a higher price than the older drugs. Ultimately, these practices artificially extend the patent holder's monopoly rights over a product beyond its intended period and delay the entry of affordable generic medicines into the market. To prevent such frivolous patents, Section 3(d) has been included in the patent laws of India and a few other countries.

Legal Complexities and High Costs

Obtaining and maintaining IPRs, especially patents, involves high costs, including legal, application, and renewal fees. This poses a major financial burden on individual inventors and small businesses. Furthermore, IPR disputes are often highly complex and require specialized legal expertise, leading to prolonged, expensive court battles. This situation highly favors large corporations with deep pockets and disadvantages smaller players. The interpretation and enforcement of IPR laws can also vary significantly from country to country, causing uncertainty and confusion for creators and businesses operating globally.

Global Inequalities

Disparities in IPR laws across nations, along with significant knowledge gaps regarding these regulations, contribute to global inequalities in access to new inventions and technologies. This severely impacts developing countries. These nations may struggle to provide their populations with patented products essential for their economic development or public health.

Strict IPR laws make it difficult for developing countries to adopt, modify, and use existing technologies locally. Historically, a key path for technologically underdeveloped nations to achieve industrial growth has been to study inventions from other countries, make improvements, and initiate their own production. Today's stringent laws eliminate these opportunities. This obstructs the transfer of technology and knowledge, reduces the likelihood that these nations will "catch up", and widens the technological gap between rich and

developing countries. Consequently, technological monopoly is concentrated in the hands of a few companies, ultimately hampering global progress.

Patent Trolls, Patent Blocking, and Trademark Bullying

Patent Trolls are entities that acquire patents primarily for licensing or litigation, rather than for manufacturing or producing goods under those patents. They do not manufacture or produce products based on these patents. Instead, they file lawsuits or issue threats against others, alleging patent infringement and seeking royalties or settlement fees. Patent trolls can be individuals, companies, or shell corporations that misuse the patent system to generate income without contributing to new inventions or social value. Their activities often suppress innovation and impose unnecessary costs on legitimate businesses.

Patent Blocking is the practice of companies acquiring patents not for actual use but to prevent competitors from utilizing those inventions. This practice can hinder the natural evolution of technology and intentionally delay new inventions from reaching the market. It eliminates competition and hinders innovative products from reaching the public.

Trademark Bullying is the utilization by large companies of their extensive trademark portfolios to intimidate or threaten small businesses or individuals, even when there is no clear infringement of their rights.

Reduction in Quality

Although IPR laws protect the originality of creations, once the term expires, others are legally permitted to copy, modify, and use the creation. In certain circumstances, widespread reproduction without quality control can gradually erode the originality or established quality of the original creation.

IPR and Digital Technology

The detrimental impact of Intellectual Property Rights extends to the very foundation of the digital world. In the realm of computer software, IPR, particularly copyright and software patent laws, has generated significant debate. Software, unlike traditional industrial products, is essentially a creative and intellectual construction that thrives on modification, reuse, and collaboration. However, strict copyright

enforcement turns software into a proprietary commodity, restricting users' ability to study, modify, or redistribute it. This not only curtails innovation but also undermines the collective and cooperative nature of knowledge production in the digital era.

The concept of software patents has further complicated this scenario. By allowing patents on algorithms, user interface designs, and even general computing methods, large corporations have created extensive 'patent thickets'—dense webs of overlapping patent claims. These thickets do not just protect genuinely novel ideas; they often cover simple, abstract processes, such as 'one-click purchasing' or 'data synchronization.' This forces new entrants and independent developers to spend enormous time and capital on legal clearance rather than innovation, acting as an effective tax on creativity and limiting technological diversity. This practice limits technological diversity, stifles creativity, and creates an artificial scarcity in a domain where replication and improvement have near-zero marginal cost.

Proprietary software licensing also reinforces a digital monopoly. End-User Licence Agreements (EULAs) frequently prevent users from inspecting the source code or adapting the software to meet local needs. This model ensures that control over technology remains centralized within a few multinational corporations. Consequently, developing countries become dependent on expensive imported software, mirroring the dependency they face in the pharmaceutical sector for patented medicines. The inability to access or customize source code also obstructs educational and research activities, depriving students and researchers of the opportunity to understand how the technology they rely on works.

The enforcement of digital restrictions through Digital Rights Management (DRM) technology presents another layer of anti-competitive control. DRM is a technical mechanism embedded within software, media, and digital devices that is designed to police and restrict user activities, such as copying a file or transferring a book. These restrictions are often backed by laws such as the U.S. Digital Millennium Copyright Act (DMCA), which make circumventing technological locks illegal, even for purposes that would otherwise be fair use. This effectively delegates copyright enforcement authority from the legal system to the code itself, creating a surveillance-like environment in which the programer, not the user, dictates the device's behavior.

In contrast, the Free Software Movement, rooted in the principles of freedom, cooperation, and knowledge sharing, presents a direct ethical and practical alternative to the IPR-dominated digital economy. Free Software, by guaranteeing the four essential freedoms, use, study, modify, and share, redefines knowledge as a common good rather than a private commodity. It restores the spirit of collective innovation that once characterized the early history of computing. Moreover, it embodies a democratic approach to technology that aligns with the broader vision of open science and universal access to knowledge.

The conflict between proprietary and free software models encapsulates a deeper philosophical divide: whether knowledge should serve the collective advancement of humanity or the commercial interests of a few. As digital technologies become ever more central to education, governance, and communication, the monopolization of software through IPR represents not only an economic concern but a profound moral and governance crisis. It determines who controls the tools of thought, governance, and creation in the information age. Handing this power to a few corporations via IPR effectively privatizes digital infrastructure, making the question of who controls the source code as fundamental to human progress as universal access to medicine or education.

Consequences in the Health Sector

Beyond the general economic and social disadvantages, IPR laws have particularly severe consequences for the health sector. They pose critical challenges to achieving Universal Health Care that is affordable and accessible to everyone worldwide.

Exorbitant Drug Prices

Patents grant pharmaceutical companies a legal monopoly over their patented drugs for a long period (typically 20 years). During this protected period, they can charge prices for life-saving medicines, diagnostic techniques, and advanced medical equipment that are many times higher than the actual production costs. This exorbitant pricing renders life-saving treatments inaccessible to millions of people in low-income countries and to economically disadvantaged populations in developed nations. This is a tragic denial of social justice, where treatment is unavailable even when death is imminent.

Neglected Diseases

The patent system primarily operates based on the potential for profit. Consequently, pharmaceutical companies invest large sums in research and development for diseases prevalent in wealthy nations, as consumers there can afford to pay high prices. However, certain diseases that predominantly affect the world's poor, often termed Neglected Diseases or "Poverty Diseases" (e.g., Sleeping Sickness, Chaga's Disease, Leishmaniasis), are underfunded and lack adequate research support. Because affected populations lack the capacity to pay high drug prices, pharmaceutical companies have little incentive to invest in research to develop such medicines. This situation exposes the cruel face of a system that prioritizes profit over the lives and health of millions of human beings.

Creating Health Inequality

As with drugs, patented medical equipment (e.g., advanced diagnostic machines, specialized surgical tools) and rapid diagnostic tests for infectious diseases also carry exorbitant prices. As a result, public health systems in developing countries and impoverished regions cannot afford to purchase them. This severely limits their ability to effectively diagnose diseases, provide timely treatment, and control the spread of infection, thereby deepening health inequality.

Delaying the Availability of Generic Drugs

Large pharmaceutical companies often use strategies such as Evergreening to artificially prolong their monopolies. They make minor and misleading changes to the drug's composition, claim the new version is "improved," and obtain a new patent. This delays the entry of lower-cost generic medicines into the market, even after the original patent expires. This forces patients to purchase high-priced branded medicines for a longer duration.

Beyond patents, certain IPR provisions, such as data exclusivity, grant additional power to patent-holding companies. Once a drug's patent expires, other companies need access to the drug's Clinical Trial Data from regulatory agencies to produce generic versions. However, Data Exclusivity laws implemented in some countries stipulate that this trial data need not be released immediately upon the patent term ending. This forces generic companies to conduct redundant human trials to gain market approval. Such unnecessary delays obstruct and prolong

the availability of affordable generic drugs after the patent for the expensive branded drug expires, thereby increasing treatment costs.

Hinders Local Production

Strong IPR protection, especially the Product Patent regime enforced by the TRIPS Agreement (Trade-Related Aspects of Intellectual Property Rights), mandated for World Trade Organisation member states, and the extended patent term, eliminated developing countries' ability to independently develop low-cost generic drugs. This reduced competition in the health sector and forced these nations to rely more heavily on expensive, imported, patented medicines.

In contrast, the Indian Patent Act, which came into force in April 1972, implemented a Process Patent system. This allowed Indian companies to manufacture and market branded drugs patented in foreign countries using an alternative production method. The drug patent term was also limited to 7 years. Consequently, within 3–4 years, Indian companies began supplying innovative drugs patented abroad at lower prices in India and other countries.

It was Indian companies that made affordable, high-quality medicines available in most developing nations, replacing the expensive drugs of large multinational corporations. It is internationally acknowledged that the global control of the frightening AIDS epidemic was achieved because low-cost Indian generic drugs were made available to poor AIDS patients. This led to the Indian pharmaceutical sector being dubbed the "Pharmacy for the Developing World" and the "Drug Store of the Poor."

However, in accordance with World Trade Organisation regulations, the TRIPS rules were implemented in India from January 2005. This replaced the Process Patent system with the Product Patent system. This change eliminated the possibility of manufacturing drugs at low cost through alternative production methods. Moreover, the patent term was raised to 20 years. As a result, the Indian public is now compelled to purchase expensive, new patented medicines for prolonged periods.

IPR and Universal Health Care

IPR restrictions on essential medicines, vaccines, and diagnostic tools have severe repercussions during public health emergencies. As witnessed during the HIV-AIDS and COVID-19 pandemics, such

controls directly caused the rapid spread of preventable diseases and the loss of countless lives. This conflict between corporate profit and global public health raises profound ethical questions.

The high cost of patented medicines, vaccines, and medical technologies places a heavy burden on health budgets, pushing developing countries into severe financial crises. This compels governments to make complex and often ethically difficult decisions about which diseases to prioritize and how many people to treat or vaccinate. This situation, which eliminates the possibility of saving countless lives, significantly weakens the goal of Universal Health Care.

This fundamental humanitarian crisis has led to the emergence of alternative IPR initiatives and innovative R&D models, such as Compulsory Licensing and Open-Source Drug Discovery (OSDD), which promote collaborative research. Public health movements continue to campaign against the social and ethical consequences of a patent system that puts a price on human life, asserting that comprehensive changes to current IPR policies are essential to prioritize human lives and achieve the goal of Universal Health Care.

NOTES

Kary Banks Mullis the American biochemist, gained global recognition through his invention of the Polymerase Chain Reaction (PCR) technology. PCR enables the amplification of even a small segment of DNA into billions of copies. This technology brought about revolutionary changes in numerous fields. These include forensic science, disease diagnosis, and genetic research. Mullis developed the PCR concept while working as a DNA chemist at Cetus Corporation in 1979. After leaving Cetus in 1986, he worked as a private consultant in biochemical research. He advised various institutions. He was awarded the Nobel Prize in Chemistry in 1993. Mullis passed away on August 7, 2019, at the age of 74. Beyond his scientific discoveries, Mullis was also known for some controversial views. These included climate change and HIV.

Philip Leder was the head of the Department of Genetics at Harvard Medical School. He led discoveries that had a major impact on cancer

research. One of his most notable contributions was the development of the Oncomouse, a genetically modified mouse. Leder and his colleague Timothy A. Stewart developed the Oncomouse in the early 1980s. These mice were genetically altered to carry a specific cancer-causing gene (Oncogene). They became crucial experimental models for studying cancer and finding new treatment methods. Leder played a decisive role in the early advances in DNA Sequencing. This involves determining the structure of the human genome. His contributions to genetics and cancer research have earned him numerous accolades. The contributions of Philip Leder to understanding the fundamental genetic secrets of life and increasing knowledge about diseases are immense. Born in November 1934, Leder passed away in 2020.

Compulsory Licensing

The patent system grants certain monopoly marketing rights to companies and institutions that invent innovative drugs. This accounts for the costs involved and provides an incentive. For a specified period, only the patent holder has the right to market the patented product. However, to ensure public access to drugs, Compulsory Licensing (CL) has been included in the patent laws of many countries.

Under CL, the Patent Office can grant non-patent holders the right to manufacture a patented drug under certain circumstances. These include exorbitant drug prices, drug shortages, or the patent holder's inability to produce the drug in quantities required by the country. Other situations can be the need to procure drugs for free distribution in the government sector, or failure to manufacture the drug within a specified period after the patent is granted. Many countries have granted companies permission to manufacture drugs under the CL provision.

In 2013, India made history by granting an Indian company permission to manufacture a cancer drug under the CL. The then Controller General of Patents, Shri P. H. Kurian, issued an order granting the Indian company Natco the right to produce Sorafenib tosylate. Sorafenib tosylate is prescribed for patients with advanced kidney and liver cancer. This drug is marketed by the German company Bayer Corporation under the brand name Nexavar**.** A month's treatment with Nexavar costs ₹ 2,80,428. This totals ₹ 33,65,136 for a year.

Indian companies, Cipla and Natco, manufactured and marketed high-quality, low-cost Sorafenib using different production methods.

Cipla's drug costs 30,000 for a month's treatment. Natco's costs are merely ₹8,800. Bayer filed a lawsuit against both companies alleging patent infringement. Meanwhile, Natco applied to the Patent Controller for permission to sell its drug under the CL provision. The Patent Controller accepted Natco's application for consideration. Bayer's cases were dismissed by the Bombay and Delhi High Courts. Both companies then presented their arguments before the Patent Controller General for 18 hours over three continuous days. Shri Kurian issued the order after considering the arguments of both companies. He also reviewed the opinions of international health organisations, such as the World Health Organization (WHO) and United Nations Children's Fund (UNICEF), as well as those of patent experts, including Carlos Correa and James Love. Both experts have prepared several authoritative documents regarding the pharmaceutical industries in developing countries. The decision was based on a comprehensive understanding of the facts. It was made without compromising public interest.

However, subsequent applications from Indian companies for CL, despite claims of the ability to produce multiple drugs at lower costs, were rejected by the following Patent Controllers. These rejections indicated that later officials took a stricter approach to granting such licences than in the initial case involving Sorafenib.

CHAPTER THREE

International Trade Agreements and Intellectual Property Rights

Although Intellectual Property Rights (IPR) laws differ across nations, several significant international agreements have been established to facilitate global trade and promote innovation. These agreements, however, often work against the interests of developing countries and adversely affect them.

GATT, GATS, and the World Trade Organisation

Following World War II, the General Agreement on Tariffs and Trade (GATT) came into effect in 1948, aiming to regulate international trade and reduce tariffs. It primarily focused only on the trade of goods. Initially, IPR was not within the purview of the GATT agreement. However, major shifts in global trade policies occurred with the Uruguay Round of Negotiations, which lasted from 1986 to 1994. These negotiations led to the formation of the World Trade Organisation (WTO), a permanent international institution that replaced GATT on January 1, 1995. The primary responsibilities of the WTO were to facilitate trade among nations, establish trade rules, and resolve trade-related disputes.

When the WTO was established, its scope was expanded to cover not just trade in goods but also trade in services and Intellectual Property

Rights. At this time, the General Agreement on Trade in Services (GATS) was also established to regulate trade in services. However, IPR was not explicitly included in the GATS agreement.

When the WTO was founded, a new agreement, the Trade-Related Aspects of Intellectual Property Rights (TRIPS), was formulated, linking IPR to trade. The primary driving force behind the inclusion of the TRIPS agreement was intense pressure from developed nations, such as the United States and European countries. They sought global protection for their companies' inventions to maximize profits. They argued that this agreement was essential to prevent their products from being easily copied in countries with weak IPR regimes.

With the TRIPS agreement, IPR was no longer confined to the domestic laws of individual countries; it became an integral component of international trade law. The TRIPS agreement mandated that member countries adhere to minimum standards of protection across various areas of IPR, specifically for Patents, Copyrights, Trademarks, and Trade Secrets.

This posed significant challenges for developing countries in providing their citizens with low-cost medicines and technology. The stricter patent protection meant that the right to manufacture many drugs and other products became confined solely to monopoly corporations.

TRIPS Agreement Against Developing Nations

The provisions of the TRIPS agreement regarding Intellectual Property, which were essentially imposed on developing countries, turned into major obstacles to their development goals and public health protection. Before the TRIPS agreement, many developing countries, including India, had the autonomy to adjust their patent laws to meet the needs of their people.

For instance, under the 1970 Indian Patent Act, Product Patents were not granted for medicines; instead, patents were granted only for the Process (manufacturing method). With a short patent term of just 7 years, Indian companies were able to develop new manufacturing processes and swiftly produce generic medicines equivalent to patented products at a very low cost once the patent term expired. This brought about revolutionary changes in the public health sector by ensuring the availability of low-cost medicines.

However, under the TRIPS agreement, Product Patents became mandatory for all inventions, including medicines, for a minimum of 20 years. This granted patent owners a monopoly, becoming a major impediment to the availability of affordable medicines. When new drugs received patents, the production of generic versions was blocked. Naturally, drug prices skyrocketed, imposing a huge burden on public health budgets and the treatment expenses of the common people.

Although the TRIPS agreement promised to encourage technology transfer, the rigid patent protection became a barrier for developing countries in acquiring and assimilating technology. The lack of obligation on patent owners to transfer their technology, combined with the imposition of high licensing fees, created a crisis in the manufacturing sector. The consequence was a stagnation in the industrial growth and research capacity of developing countries.

By ratifying the TRIPS agreement, the policy freedom of developing countries to formulate and implement patent laws was significantly diminished. They lost the authority to modify patent laws to reflect their specific local circumstances and development needs, thereby limiting governments' ability to safeguard public interests.

While the TRIPS agreement acknowledges governments' right to issue a Compulsory Licence to manufacture drugs without the patent holder's permission during public health emergencies, exercising this right has faced numerous legal hurdles and intense international pressure. This severely impacted the availability of medicines during global pandemics like AIDS and COVID-19. As priority was given to patent holders' interests, developing countries struggled to procure essential medicines even in emergencies.

The TRIPS provision, which allowed treating Parallel Imports (where a product sold at a lower price in one country is imported into another) as an infringement of import patent law, helped multinational companies charge different prices for the same medicine in different countries. This effectively blocked a key avenue for developing countries to obtain medicines at lower costs.

Furthermore, some TRIPS provisions paved the way for patenting plants, animals, and microorganisms, endangering the indigenous biodiversity and traditional knowledge of developing countries. The local seed rights and traditional farming methods of farmers

in developing countries came under threat. This often created an environment conducive to Biopiracy, where foreign companies obtained patents based on the traditional knowledge of these communities.

The strong IPR legislation and its strict enforcement, in line with TRIPS provisions, imposed a substantial financial burden on developing countries. The resources required to establish and maintain IPR-related mechanisms often necessitated cuts in essential sectors, such as public health and education.

Additionally, the strategy of 'Evergreening,' where pharmaceutical companies secure new patents by making minor modifications to their drugs just before the original patent expires, became widespread by exploiting loopholes in the TRIPS agreement. This delayed the production of generic medicines, forcing patients in developing countries to use expensive drugs for a prolonged period.

For these reasons, the TRIPS agreement is often criticized for hindering the development goals of developing countries and rendering them the most vulnerable link in the chain of international trade laws.

The Doha Declaration: A Small Respite

Recognizing that the TRIPS Agreement on Intellectual Property Rights, particularly regarding the availability of medicines, was creating serious problems for global public health, member countries of the World Trade Organisation (WTO) convened in Doha, Qatar, in 2001, and issued a landmark proclamation. This crucial document, known as the Doha Declaration on the TRIPS Agreement and Public Health, is also referred to as the "Doha Flexibilities."

The Declaration unequivocally stated that nations have the right to introduce flexibilities within the TRIPS Agreement to protect public health, especially to ensure that essential medicines are accessible to everyone. The Doha Declaration fully endorsed rights such as Compulsory Licensing (as provided in Indian patent law), which allows a government to grant a licence to other companies to manufacture a patented medicine for public health needs without the patent owner's consent. This provided legal authorization for developing countries to produce low-cost generic drugs in urgent and emergency situations. Furthermore, the Declaration underscored that the sovereign right to determine what constitutes a public health emergency rest with each nation.

The Declaration also opened a path for countries that lack the capacity to manufacture drugs themselves to import them from other nations that produce the medicines under a Compulsory Licence. Even if a product is patented in one country, the Parallel Import flexibility under the TRIPS agreement allows it to be imported from another country where it is available at a lower price.

The Doha Declaration gained significant international recognition, establishing that public health must take precedence over Intellectual Property interests. It helped developing countries more easily access low-cost medicines to combat deadly diseases such as HIV/AIDS, Malaria, and Tuberculosis, thereby instilling a new hope in the global health sector.

It is essential to note, however, that the Doha Declaration did not completely overhaul the fundamental structure of the TRIPS agreement; instead, it merely identified interpretations and flexibilities within the existing provisions for the protection of public health.

Free Trade Agreements and the Strategy for Universal Patents

Free Trade Agreements (FTAs) are legal treaties concluded between countries to facilitate trade and strengthen economic cooperation. These agreements not only involve reducing or eliminating import duties on products but also include provisions across various sectors such as services, investment, and Intellectual Property Rights (IPR) protection.

When it comes to IPR protection, FTAs often incorporate stricter provisions than the World Trade Organisations TRIPS Agreement. These are collectively referred to as TRIPS Plus provisions. Wealthy nations and powerful multinational pharmaceutical companies strategically use FTAs to further strengthen their patent protection and maintain their global monopoly rights.

"TRIPS-Plus": The Challenges Facing Developing Countries

FTAs containing "TRIPS-Plus" provisions are detrimental to developing countries in several ways:

Patent Term Extension: These agreements may demand that the patent term for medicines be extended further beyond the 20 years

stipulated in the TRIPS agreement. For instance, certain provisions in the US-Jordan FTA and the formerly debated Trans-Pacific Partnership (TPP, now CPTPP) focused on extending the patent term to compensate for delays in the patent-granting process. This provision causes a significant delay in the market entry of low-cost generic drugs, posing a major challenge to public health.

Data Exclusivity Law: Another provision being pushed through FTAs to effectively neutralize Compulsory Licensing is the Data Exclusivity law. This also constitutes a deviation from WTO regulations. When a patent for a medicine is granted, all related information, including the drug's efficacy, side effects, and clinical trial data, must be submitted to the Drug Controller. After the patent term expires, this information becomes available to anyone interested. Companies marketing low-cost generic drugs after the patent term use this information as the basis for their production. (Only in the case of a few specific medicines do generic companies need to prove the Bioavailability of their drugs through separate trials).

The TRIPS provision only mandates Data Protection to prevent other companies from misusing the clinical trial data for commercial purposes during the patent term. However, the current push is not for TRIPS-compliant Data Protection but for Data Exclusivity, which ensures that clinical trial data is not released under any circumstances for 5 years after the patent is granted. If the Data Exclusivity law comes into effect, it will render the use of Compulsory Licensing impractical for five years following the patent grant. Since clinical trial data will be unavailable, securing approval for drug production would necessitate collecting the information through new, costly, and time-consuming trials. Given this expense and delay, other companies would be hesitant to apply for Compulsory Licensing. Thus, the Compulsory Licensing provision, meant for emergencies, would be rendered ineffective in practice.

Furthermore, the new law raises another ethical issue: administering medicines of proven efficacy to humans for re-trial purposes goes against medical ethics. Additionally, these agreements further encourage strategies such as "Evergreening," in which patents are sought by making minor alterations to existing drugs. While the TRIPS agreement offered limited means to counter this, the legal support provided by FTAs for such tactics effectively eliminates access to low-cost medicines.

Circumventing Doha Flexibilities

It is noteworthy that FTAs attempt to bypass both the World Trade Organisation and the flexibilities provided by the Doha Declaration under the TRIPS agreement. In the WTO, all member countries have voting rights and an opportunity to present their interests. However, since FTAs are primarily agreements between two or more countries, stronger nations can easily exert pressure on financially weaker nations to impose stringent IPR laws favorable to themselves. This effectively weakens the public health flexibilities granted by the Doha Declaration.

Anti-Counterfeiting Trade Agreement: Another Monopolistic Tactic

The Anti-Counterfeiting Trade Agreement (ACTA) is another international framework developed by the US, the European Union, and other countries as part of a strategy by developed nations. This tactic aims to secure commercial interests through alternative means that they could not fully achieve through the World Trade Organisation (WTO). ACTA incorporates provisions that are more stringent than TRIPS regarding commercial transactions, and its conditions are therefore considered part of the TRIPS Plus regime.

This draconian law, ACTA, grants the power to importing countries and transit countries to seize and destroy low-cost generic drugs being exported to foreign countries, classifying them as "counterfeit medicines."

Under the Doha Flexibilities, countries lacking the technical capacity to produce drugs may import generic medicines from countries that do. ACTA can be used to label these legally imported medicines as counterfeit and seize them. Furthermore, ACTA includes provisions that allow companies claiming patent rights over genetic structures to restrain manufacturers from marketing generic versions of those drugs, solely based on a complaint. The agreement authorizes action without waiting for an explanation from the manufacturers. In fact, ACTA is criticized for failing to provide a clear definition of what constitutes a counterfeit product.

The scope of ACTA extends beyond medicines to include genetically modified crops and the communication of information via the Internet and social networks. ACTA grants Internet Service Providers

(ISPs) the authority to block the downloading of information, remove content deemed unfavorable, and even disconnect internet access. This poses a significant setback to the free flow of knowledge, a core strength of the Internet.

The secret meeting to draft ACTA was held in 2007 and involved the United States, the European Union, Switzerland, and Japan. Subsequently, countries including Australia, Canada, Mexico, Morocco, and New Zealand joined the initiative, and a second round of discussions took place in Geneva in 2008. After eight more meetings, the final draft of ACTA was prepared and approved by thirty-nine countries in 2010. These nations control over 70 percent of global commerce.

Following the public release of the ACTA provisions, several nations, including India, Brazil, and China, strongly opposed the agreement. Moreover, ACTA was not ratified in Europe after 633 members of the European Union Parliament voted against it in 2012.

Towards a Universal Patent Regime?

Currently, a "Universal Patent," a single patent system applicable to all countries, does not exist globally. Instead, separate patent applications must be filed and approved in each country. However, powerful efforts are underway, through FTAs and other international pressure, to impose the same strict patent laws and protection periods worldwide.

The World Intellectual Property Organisation (WIPO), an agency under the United Nations, advises countries on the standardization and harmonization of intellectual property laws. There are ongoing efforts to draft more stringent patent laws through WIPO and to present them to the WTO for approval. This attempt to globally unify patent systems is viewed as another tactic to increase the financial dominance of developed nations and multinational corporations.

If this objective is realized, monopoly corporations will be able to sell patented products at the same high price in every country. This would lead to a situation in which essential goods, particularly life-saving medicines, become unavailable to poor populations in developing countries.

Although discussions on this matter are taking place on the platforms of international organisations such as the WHO and WIPO, as well as at the UN level, efforts to fully harmonize patent laws globally have

not yet been fully successful due to disputes related to sovereignty and developmental needs. Nevertheless, powerful nations continue to exert pressure to achieve this goal through bilateral FTAs and multilateral trade alliances.

International Intellectual Property laws, especially the TRIPS Agreement and the Free Trade Agreements that go beyond it (TRIPS Plus), are being applied to protect the interests of wealthy nations and large corporations. These moves push developing countries backward in terms of technology and healthcare, making knowledge and life-saving products inaccessible to the general public. This is precisely why movements like the Free Software movement emphasize the free sharing of knowledge and strongly oppose the monopolistic tendencies of intellectual property rights.

International Intellectual Property laws, particularly the TRIPS Agreement and the FTAs that extend beyond it, have become orchestrated strategies, conceived solely to protect the selfish interests of rich nations and large corporations, and are now being used against developing countries. These unilateral moves push developing nations into severe crises and keep knowledge and life-saving products out of reach of ordinary citizens. It is in recognition of this that the Free Software movement champions the free sharing of knowledge and fearless challenges and staunchly resists the monopolistic tendencies of Intellectual Property Rights.

NOTES

World Trade Organisation

The World Trade Organisation (WTO) is a global institution that formulates, standardizes, and implements the rules governing international trade. Established in 1995, the WTO operates to make international trade as smooth and free as possible. Its primary responsibilities include providing a forum for international trade negotiations and facilitating the resolution of trade disputes.

The WTO's highest decision-making body is the Ministerial Conference, which comprises representatives from all member nations and convenes at least once every two years. Day-to-day operations are

managed by the General Council. The WTO structure also includes councils for Goods, Services, and Intellectual Property Rights (IPR), as well as a Dispute Settlement Body.

The main agreements that govern the WTO's functioning are the General Agreement on Tariffs and Trade (GATT), which regulates the trade of goods; the General Agreement on Trade in Services (GATS), which establishes rules for the international trade of services; and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which sets standards for protecting IPR, including copyrights, patents, and trademarks.

The TRIPS Agreement is what directly connects the WTO to the realm of Free Software, as it provides copyright protection for software. TRIPS often conflicts with Free Software principles, particularly those surrounding the sharing of knowledge and software. While Free Software emphasizes users' freedom to use, study, modify, and distribute software, the TRIPS agreement provides legal protection for the exclusive rights of IPR owners. The freedoms inherent in the Free Software philosophy are secured using specific copyright laws.

World Intellectual Property Organisation

The World Intellectual Property Organisation (WIPO) is a specialized agency of the United Nations dedicated to promoting the global protection of Intellectual Property (IP) and ensuring cooperation among various nations. Established in 1967, WIPO's headquarters are in Geneva, Switzerland. WIPO's stated objective is to improve the protection of intellectual creations worldwide and to encourage innovation and creativity.

WIPO manages numerous treaties that establish international standards for IP protection. The most important among them include: The Berne Convention, concerning the protection of copyrights for literary and artistic works, The Paris Convention pertains to the protection of industrial property rights, including patents, trademarks, and industrial designs, The WIPO Copyright Treaty (WCT) addresses copyright protection in the digital age.Through these agreements, WIPO provides technical assistance to member states to strengthen IP protection and facilitate international patent and trademark registration systems.

WIPO's activities are relevant to the Free Software movement because software is protected by copyright. However, while the Free Software

philosophy emphasizes the user's freedom to use, study, modify, and distribute software, WIPO's focus remains on strengthening the traditional rights of Intellectual Property owners. Nevertheless, Free Software licences (such as the GNU GPL) use copyright law itself as the legal tool to secure the freedoms fundamental to their philosophy. Thus, Free Software puts forward its distinct conditions while operating within the common framework of Intellectual Property protection.

Free Trade Agreements: Challenges Facing India

The ongoing Free Trade Agreement (FTA) negotiations between India and countries such as the United States (US), the United Kingdom (UK), and the European Union (EU) are raising serious concerns about their potential impact on the nation's public health system and the accessibility of medicines. Patient groups, tuberculosis survivors, HIV-affected individuals, and health organisations have voiced their profound worries about this issue.

There is deep apprehension that these agreements will weaken the public health safeguards embedded in India's patent law and introduce new Intellectual Property (IP) protections such as Data Exclusivity. Such changes would significantly compromise India's ability to provide medicines at affordable prices.

The US Trade Representative has already raised concerns regarding key provisions in the Indian Patent Law, including: Section 3(d) prevents multiple patents for the same medicine by requiring minor changes, thereby curbing unnecessary monopolies, Trade Secret Protection provisions.

The US may also pressure India to eliminate the Pre-grant Opposition mechanism, a law that plays a vital role in preventing the approval of unwarranted patents. Similar demands have been made by the UK and the European Union.

These countries have historically sought to include TRIPS-plus provisions beyond the TRIPS Agreement's obligations in their FTAs and other agreements. Such clauses would remove the public health protection provisions contained within the Indian Patent Law and the Doha Declaration, thereby hindering the production and distribution of affordable generic medicines. This could weaken India's crucial position as the "Pharmacy of the Developing World."

Since 2003, affordable generic medicines manufactured in India have provided life-saving Anti-Retroviral treatment to over 20 million HIV-affected people in developing countries. India also carried out similar life-saving efforts during the COVID-19 pandemic. It is essential to protect this capacity.

India has consistently opposed TRIPS Plus provisions in past FTA negotiations and Economic Partnership Agreements. Therefore, public health activists have strongly demanded that India reject any requirement that calls for an amendment to the Indian Patent Law.

CHAPTER FOUR

The Origin of the Free Software Concept

The concept of Free Software revolutionized the computer world, reshaping not only technology development but also the culture of knowledge sharing and collaboration. This chapter traces the historical origins and philosophical foundations of the Free Software movement —from the communal spirit of early computing to Richard M. Stallman's moral vision of software freedom and the creation of the GNU/Linux system that changed the digital world forever.

The Concept of Free Software: Richard M. Stallman's Contribution

The American computer scientist Richard M. Stallman is widely regarded as the father of the Free Software movement. It was during his work as a programer in the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology (MIT) in the 1970s that this philosophical idea began to take shape in him. At that time, software was generally seen as a common social resource. Programers freely exchanged source code (the blueprints of computer programes), modified it, improved it, and shared it without restrictions. A collaborative culture of knowledge-sharing prevailed.

By the early 1980s, this changed as the computer industry expanded and software became increasingly commercialized. Initially, software

was bundled with hardware, but companies like IBM began charging separately for software as early as 1969. Later, corporations such as AT&T imposed licensing restrictions on their UNIX operating system source code, enforcing them through copyright. Emerging companies like Microsoft used copyright to keep their source code secret, denying users the right to modify, copy, or share software. This proprietary model, driven by profit, changed the software landscape.

Richard M. Stallman's Realization: The Printer Driver Incident

Stallman personally experienced the impact of this shift through an incident involving a printer driver. At MIT's AI Lab, a newly installed Xerox 9700 printer had several flaws (bugs). These included failing to notify users during paper jams and preventing users from checking the print queue before printing.

As in earlier times, Richard M. Stallman tried to fix these issues by modifying the software. But he discovered that the source code was not available. The manufacturer had withheld it, citing copyright restrictions, and had kept the code secret. This denial of society's right to share knowledge infuriated Richard M. Stallman. He declared that such practices were tantamount to obstructing both the dissemination of knowledge and technological progress. He argued that the blueprints of software—its source code—should be freely available to the public. From this pivotal experience, the seeds were sown for what would grow into the revolutionary idea and movement of Free Software.

UNIX Operating System: A Closed System

The UNIX operating system was developed in the 1970s at AT&T's Bell Labs by Ken Thompson and Dennis Ritchie. This marked a significant advancement in the field of computer science. Its structure and design stood superior to the operating systems that existed at the time. Many of UNIX's concepts were later implemented and became an inspiration for other operating systems, including Windows.

By the late 1970s, UNIX was licenced to universities and government institutions as a research tool. In its early years, source code was available, allowing programers to make modifications and add features. This access contributed significantly to UNIX's popularity and development in both academic and commercial fields.

With these advances, however, the open nature of UNIX began to recede. In the early 1980s, AT&T began to market UNIX as a commercial product. Thereafter, UNIX became a product fully governed by copyright laws. With the release of UNIX System III in 1982 and UNIX System V in 1983, stricter licence agreements and copyright restrictions were imposed. During this period, various vendors developed their own versions of UNIX (such as BSD, SunOS/Solaris, HP-UX, and AIX). This led to "UNIX wars" and fragmentation. To counter this, AT&T collaborated with companies like Sun Microsystems to merge the various UNIX variants, culminating in UNIX System V Release 4 (SVR4) in 1989.

Unix System Laboratories (USL), a subsidiary of AT&T, commercialized and brought these under copyright law. Later, in 1992, AT&T sold its UNIX business and USL to the software company Novell. Novell subsequently transferred the UNIX trademark to the industry consortium The Open Group. Although AT&T played a crucial role in UNIX's origin and early development, it was AT&T that transformed UNIX from a research project into a commercial product, effectively implementing copyright laws over it through licensing and commercialization.

The Arrival of Proprietary Software

Proprietary software protected by copyright limited user knowledge of its inner workings and required users to rely on manufacturers to resolve technical issues. This restricted user freedom and hindered the sharing of knowledge.

In this context, Richard M. Stallman conceived the idea of Free Software. He believed that making the source code of operating systems available would empower users. This prompted him to start the GNU Project, aiming to develop an open operating system. The name 'GNU' (GNU is Not Unix) emphasized its open nature. This realization transformed software from a private commodity back into a shared intellectual commons.

Copyleft

Copyleft is a foundational principle of Free Software. Unlike copyright, which keeps source code secret, Copyleft makes it available to all, ensuring software remains free. Software under a Copyleft licence can

be modified, redistributed, and improved, provided that new versions remain under Copyleft. This keeps software free for future generations.

GNU General Public Licence

The GNU General Public Licence (GPL) is an important document developed by Richard M. Stallman to legally implement the principles of Copyleft. The GPL provides legal protection for the concept of Free Software, making it sustainable and ensuring it is available to everyone. It is one of the most widely used Free Software licences in the world.

GPL guarantees four fundamental freedoms for a computer programe. Like the practice in computer science of counting from zero, these freedoms are numbered from 0 to 3:

Freedom 0: The freedom to run the programme for any purpose.

Software can be used for any purpose, personal or commercial, without restrictions, according to the user's wishes.

Freedom 1: The freedom to study how the programme works and to change it to suit one's needs. For this, the software's source code is made available to everyone. This helps in understanding the programme's functioning, correcting its errors, and making necessary modifications.

Freedom 2: The freedom to redistribute copies of the programme. The software can be shared with others at no cost or for a small fee. This encourages the spread of knowledge.

Freedom 3: The freedom to distribute copies of modified versions to others. This allows sharing the improvements made to the software with others, so the entire community benefits. Here too, the source code of the modified software must be made available.

These four freedoms are what are meant when software is called 'Free'. They place software under user control and foster a community that shares knowledge and expertise.

GNU/Linux

The GNU Project was initiated to develop a comprehensive operating system. As part of the GNU project, many programmes and tools were developed. However, there was a delay in developing the most important part of the operating system, the Kernel.

At this stage, Finnish software engineer Linus Torvalds developed a new kernel in 1991, later known as the Linux Kernel. He released it

under the GNU General Public Licence. Combining the Linux kernel with GNU Project tools (such as the Shell, Compiler, and Utilities) created a complete, free operating system—GNU/Linux. The system combines Torvald's kernel with Stallman's GNU components. Although commonly called 'Linux,' the accurate technical term is GNU/Linux.

The vision of Richard M. Stallman and the practical contribution of Linus Torvalds together laid a solid foundation for the Free Software Movement. This opened the way for knowledge sharing and the democratization of technology. Free Software has also played a significant role in the development of modern technologies, including the Internet, Cloud Computing, and Artificial Intelligence.

The term "Free" in Free Software does not mean software that is available free of cost, but rather that it ensures the freedom of the user. Stallman has repeatedly emphasized: "The Free in Free Software is not the Free in Free Beer, but the Free in Freedom." Although most Free Software is available at no cost, some Free Software programmes are sold at moderate prices. However, since all of these are free to share, they can be used on many computers. By contrast, Proprietary Software is licenced for use only on a single computer.

Commonly Used Free Software Operating Systems

Today, many operating systems that follow the principles of Free Software are available. Among them, the most important ones are the following:

1. GNU/Linux:

The most popular and widely used Free Operating Systems is GNU/Linux. As mentioned earlier, it is composed of the tools and libraries from Richard M. Stallman's GNU Project, combined with the Linux Kernel developed by Linus Torvalds. The Linux Kernel is Free Software. Based on it, many versions (distributions) are available. Each distribution is released with a different user interface, software repository, and objectives.

Important GNU/Linux distributions:

DebianB: One of the oldest and most stable Linux distributions. It is maintained entirely by a volunteer collective. Debian serves as the foundation for many other Linux distributions, including Ubuntu.

It is not marketed by any company, but rather advanced by a large community.

Ubuntu: Developed under the leadership of the Canonical company, Ubuntu is one of the most popular desktop distributions in the Linux world. Its specialty is its ease of use for new users. Although Canonical provides commercial services and technical support, Ubuntu remains a Free Software distribution.

Linux Mint: Based on Ubuntu and Debian, it offers a desktop experience that Windows users can easily adapt to. It is also led by a volunteer community.

Fedora: Sponsored by the prominent software company Red Hat and developed in collaboration with the Linux community, Fedora is an operating system based on the Linux Kernel. It is a distribution that first tests new technologies and stands at the forefront of innovation in the Linux world. While Red Hat provides financial backing and licensing for its commercial product, Red Hat Enterprise Linux (RHEL), Fedora is entirely free and community-led. Red Hat and Oracle Linux are Linux distributions with commercial support. These commercial distributions often include some non-free software. However, their fundamental Free parts are preserved as they are by Red Hat. Fedora functions as an upstream project for the development of Red Hat Enterprise Linux. That is, many technologies first tested in Fedora are later included in Red Hat Enterprise Linux. Moreover, CentOS, once developed and maintained by the community as a free version of Red Hat Enterprise Linux, also existed.

Arch Linux: A distribution designed for users with more knowledge about computers. It provides the latest software directly and gives the user complete control over the system. This is led by a volunteer community.

Regarding Linux distributions, "marketing" is different from traditional product marketing. All Linux distributions rely on a large volunteer community for support. These communities develop software, detect bugs, provide user support, and introduce it to new people. Companies like Canonical Ltd, Red Hat, and SUSE provide commercial support and services for the Linux distributions they develop or support, such as Ubuntu, Fedora, Red Hat Enterprise Linux, and openSUSE. While this serves as a source of income for these companies, it does not hinder the software's freedom. Non-profit organisations, such as

the Debian Project, coordinate the development of these software programmes. Every user is a promoter of these software programmes. Understanding the benefits of Free Software, users share it with others.

2. FreeBSD

Another major free operating system in the UNIX family is FreeBSD. Unlike the Linux Kernel, this comes from the Berkeley Software Distribution (BSD) codebase. It is widely used in servers and embedded systems. Elements of FreeBSD code can be found in many modern operating systems, including Apple's macOS. It too is led by a large volunteer community. Initially, there were two variants of UNIX: AT&T UNIX and BSD UNIX. BSD also influenced the design of the Linux system. Variants such as OpenBSD and NetBSD also exist.

3. Android: A Unique Platform

Android, developed by Google, is the world's most popular mobile operating system. Its Kernel is a modified version of the Linux Kernel. The basic codebase of Android, the Android Open-Source Project (AOSP), is Free and Open-Source, primarily licenced under the Apache Licence 2.0 and the Linux Kernel under GPLv2. However, most Android phones include Proprietary Software such as Google Mobile Services (GMS). These parts are not free. Therefore, Android does not fully come under GNU's definition of a "completely Free Operating System."

Android has mainly been developed, and its ecosystem has been shaped by Google. They licence Android to phone manufacturers and impose certain conditions on their use of Google services. Companies like Samsung, Xiaomi, and OnePlus use the Android Operating System in their phones, adding their own user interfaces and applications before marketing them.

In short, Free Operating Systems are not marketed in the traditional way. They are mainly sustained, developed, and promoted by volunteer communities, non-profit organisations, and, in some cases, commercial companies that provide services and products based on them. The essence of this movement is Freedom, Co-operation, and Sharing.

In the computer world, where the monopolization of commerce obstructed the sharing of knowledge, the Free Software Movement opened a new chapter of freedom. Based on the philosophical

foundation of Richard M. Stallman and the practical contributions of Linus Torvalds, this movement emphasizes not only software as a product but also user freedom and the democratization of knowledge. Through the principles of Copyleft and legal frameworks like the GNU Public Licence, software source code became accessible to all, unleashing infinite possibilities for innovation and collaboration.

The contributions of Free Software to the growth of modern technologies such as the Internet, Cloud Computing, and Artificial Intelligence are invaluable. By opening the path of freedom of knowledge and innovation and breaking the chains of monopolization, this movement stands as a beacon guiding the technological world of the future. In an age dominated by Artificial Intelligence, Big Data, and Cloud Computing, the core principles of the Free Software Movement—freedom, collaboration, and transparency—remain more relevant than ever. The question of who controls the code is now inseparable from who controls humanity's digital future.

NOTES

Richard M. Stallman (Richard Mathew Stallman, also known as RMS) is the pioneer of the Free Software movement. Stallman's interest in computers began at an early age. In 1970, he entered Harvard University to study Physics, and in 1971, he joined the MIT Artificial Intelligence Lab (MIT AI Lab) as a programer. Becoming part of the "hacker" culture there, Stallman developed several software programmes, such as Emacs. As restrictions on software increased, Stallman initiated the GNU Project in 1983 to ensure user freedom. In 1984, he resigned from MIT to work full-time on this project. In 1985, he established the non-profit Free Software Foundation (FSF), serving as its President without salary. By the mid-1990s, he dedicated most of his time to campaigning and lecturing on Free Software. He consistently raised his voice against software patents and the excessive expansion of copyright laws. In 2019, due to some controversies, he resigned from both his Visiting Scientist position at MIT and from the presidency of the Free Software Foundation, although his work for Free Software continues. Richard M. Stallman is still active in

spreading his ideas about software freedom through travel around the world.

Linus Torvalds is one of the most influential software engineers the world has seen. His interest in computers began at an early age. While a Computer Science student at the University of Helsinki, he began building his own operating system kernel. In 1991, he released the first version of the Linux Kernel. In 1997, he accepted a job at the microprocessor manufacturer Transmeta, relocated to California, and continued overseeing Linux Kernel development while working there. In 2003, he left Transmeta to focus solely on the Linux kernel within the Open-Source Development Labs (OSDL) consortium. In 2007, OSDL merged with the Free Standards Group to become the Linux Foundation. As part of the Linux Foundation, Linus Torvald continues to lead the Linux Kernel development process. This massive Open-Source project, with contributions from thousands of software experts, still has him as its final authority. His approach, emphasizing practicality, technical quality, and open collaboration, played a decisive role in Linux's success.

Ken Thompson is a legend in the world of computer science. Joining Bell Labs in the 1960s, he was one of the primary creators of UNIX, one of the most influential operating systems in the history of computing. Thompson played a pivotal role in developing early versions of UNIX and in designing its core structures, including the file system and the shell. His contributions include programmeming language B and the early form of Regular Expressions used in programmeming. The principles of UNIX—"Do one thing and do it well"—deeply influenced modern software development. Besides UNIX, he collaborated with his Bell Labs colleague, Dennis Ritchie, on developing the C language. He also participated in the design of operating systems such as Plan 9 and Inferno. In 1983, he won the Turing Award, the highest honor in computer science, together with Ritchie.

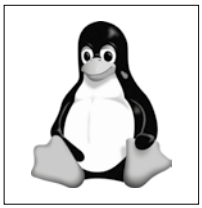
Dennis Richie (Dennis MacAlistair Richie) made invaluable contributions to computer science. Like Ken Thompson, Ritchie was a researcher at Bell Labs. He is mainly known as the creator of the C programmeming language. Developed in the 1970s, the C language became the foundation of UNIX operating systems and many other modern operating systems, programmeming languages, and software. C is one of the most widely used programmeming languages globally. Together with Ken Thompson, Ritchie played a decisive role in

developing the UNIX operating system. Most of the UNIX system's code was written in C, making it portable and efficient across platforms. Through his development of C and his role in UNIX, Ritchie laid the foundational stones of the modern computing world. In 1983, along with Ken Thompson, he was awarded the Turing Award, the highest honour in computer science. He passed away on October 12, 2011.

GNU and the Logo of the Free Software Movement

"GNU" is a recursive acronym. A recursive acronym is an acronym that refers to itself within its own name. In the case of GNU, which stands for 'GNU's Not Unix', the first letter 'G' represents the entire acronym 'GNU' again. This creates an infinite loop where the full name is embedded inside the abbreviation, a style of naming that was a popular form of humour among the early computer programmer culture at MIT.

The Symbol of Linux – Tux the Penguin



It was Linus Torvalds himself, the creator of the Linux Kernel, who decided to choose the penguin as the official logo of Linux. This penguin logo is known as "Tux." Torvalds was a great admirer of penguins. It is said that an incident when a small penguin bit him during a zoo visit inspired this. Although the bite led to illness, he took it in good humor. This incident created a special affection for penguins in him. In 1996, Torvalds demanded that Linux have an official symbol. He decided to select it through a contest and specified that he wanted the picture of a "happy penguin." Among numerous entries, Torvalds chose the penguin image designed by programer Larry Ewing, who created it using the free software GIMP. Later, the image was named "Tux." It is believed the name came as a short form of "Torvalds' UniX". Some connect it to the word "Tuxedo," a black formal suit worn by men, since the penguin's black and white colours resemble it. Tux represents Linux's free and open nature and its friendly approach. It quickly became a beloved symbol in the Linux community. Today, Tux is an inseparable part of every Linux distribution. Along with Linux's technical excellence, Tux, as a simple symbol, has played a major role in uniting the Linux community and increasing its popularity.

CHAPTER FIVE

Creative Commons: The Creative Expansion of the Free Software Philosophy

Just as the idea of Free Software initiated a revolutionary new vision in the world of computing, Creative Commons (CC) has, through its intellectual property licences, articulated a novel approach to sharing knowledge, art, and other creative works. The eminent legal scholar and cyber law expert, Professor Lawrence Lessig, is the chief architect of this initiative. The Creative Commons licences were designed, drawing inspiration from the principle of "freedom" advocated by the Free Software movement. The American computer programer, Aaron Swartz, also played a major role in the founding of Creative Commons.

The Origin of Creative Commons: A Response to the Restricted Digital World

In the early 2000s, digital content, including music, images, writings, and videos, could be easily shared and distributed over the internet. However, existing copyright laws created major obstacles to this sharing because all creative works were strictly governed by the 'All Rights Reserved' condition. Lawrence Lessig observed that this hindered the natural flow of information and creativity.

The Free Software philosophy, as demonstrated by licences such as the GNU Public Licence (GPL), allows people to use and improve software with greater freedom. Lessig argued that just as the blueprint (source code) of software was made free, a similar licensing system should exist for other creative works. He recognized the need for a simple mechanism that would allow ordinary people to easily choose how much freedom to grant their creations.

It was from this viewpoint that Lessig founded Creative Commons (CC), a non-profit copyright organisation, in 2002. The core of this initiative was to introduce a new approach: 'Some Rights Reserved'. This allowed artists and writers to clearly and simply define which uses of their creations were permitted and which were restricted.

Features of Creative Commons Licences

Creative Commons licences are fundamentally composed of four basic elements. These elements are combined in various ways to create six main licences. Creative Commons licences give creators the freedom to choose the publication method that best aligns with the nature of their work and their interests.

Basic Elements:

1. **Attribution (BY):** Licences that include this element mandate that the original creator be given Attribution when the work is used. Acknowledging the creator is a crucial element common to all Creative Commons licences.
2. **Non-Commercial (NC):** Licences containing this element prohibit the use of the work for Commercial Purposes. The work may only be used for personal or educational non-commercial purposes.
3. **NoDerivatives (ND):** Licences with this element do not allow any changes to be made to the creation. It can only be used and shared in its original form.
4. **Share Alike (SA):** This element is like the 'Copyleft' principle in Free Software. It mandates that if a new work is created from a licenced work with modifications, the new work must also be shared under the same Creative Commons licence. This ensures the continuity of freedom.

Major Creative Commons Licences

By combining these four elements, the following six main licences have been formulated. The freedoms granted by each licence vary:

- **CC BY (Attribution):** Grants complete freedom to anyone to use, modify, and share the work for any purpose (including commercial uses), provided Attribution is given to the original creator.
- **CC BY-SA (Attribution-Share Alike):** Allows anyone to use the work for any purpose, provided Attribution is given, and any modified versions are shared under the same licence. As this is like the GPL in Free Software, it is also called a "Free Culture Licence."
- **CC BY-NC (Attribution-Non-Commercial):** Grants freedom to use, modify, and share the work for Non-Commercial purposes, provided Attribution is given.
- **CC BY-ND (Attribution-NoDerivatives):** Allows the work to be shared by anyone for any purpose (including commercial uses), provided Attribution is given, and no modifications are made.
- **CC BY-NC-SA (Attribution-Non-Commercial-Share Alike):** Grants freedom to use for Non-Commercial purposes, modify, and share the work under the same licence, provided Attribution is given.
- **CC BY-NC-ND (Attribution-Non-Commercial-No Derivatives):** Permits the work to be shared only for Non-Commercial purposes, with no modifications, and requires Attribution. This is the most restrictive of the Creative Commons licences.

CC0 is particularly valuable for releasing scientific data, government works, and educational materials, as it allows creators to waive all rights and ensure their work remains entirely in the public domain for unrestricted reuse.

Additionally, there is a special licence called **CC0 (Creative Commons Zero).** This helps place a creation into the Public Domain. This means anyone in the world can use and modify the work for any purpose, without any restrictions, and without even needing to provide attribution. This signifies that the creator has waived all their rights.

Versions of Creative Commons Licences

The 4.0 version of Creative Commons licences, released in 2013, unified international legal standards by simplifying attribution and eliminating the need for country-specific (ported) versions, enhancing their global enforceability.

Creative Commons licences have evolved over time. Various Versions, from 1.0 to 4.0, are currently in use. Each new version aims to increase legal clarity and achieve greater compatibility with legal systems worldwide. For example, 'Unported' licences are those not rewritten to conform to the laws of a specific country. In contrast, 'International' versions are designed for easier worldwide use.

Currently, the **Creative Commons Attribution 4.0 International (CC BY 4.0)** licence is the most recent and widely used version. However, older versions, such as the 3.0 Unported licence, are still used for many creations today.

The Impact of Creative Commons: Democratization of Knowledge

Creative Commons (CC) has had a revolutionary impact on the sharing of knowledge and creativity worldwide. The fundamental goal of Creative Commons is the expansion of knowledge. Collaborative encyclopedias such as Wikipedia (which itself is licenced under CC BY-SA), Open-Access Journals, and Open Educational Resources (OER) are widely distributed under Creative Commons licences. This extensive adoption significantly contributes to the spread and democratization of knowledge globally. Examples of this global adoption abound, including Flickr (hosting millions of CC images), YouTube (offering CC BY licensing for creators), and UNESCO's OER initiatives, all of which rely extensively on the Creative Commons framework.

By enabling creators to choose exactly how much freedom they want to grant to their works, CC licences effectively Foster Creativity. This framework inspires the creation of new works and provides abundant opportunities for building upon the creations of others, fostering a collaborative cultural environment.

One of the most powerful contributions of Creative Commons is the legal clarity it provides. CC licences help even ordinary people who may not have a deep understanding of complex copyright laws easily

grasp their rights and those of others. Each CC licence operates on three distinct layers to ensure this clarity: the legal code, which is the official legal text intended for lawyers to read and understand; the human-readable Summary (Commons Deed), which is a simple, icon-based explanation that is easy for the public to quickly understand; and finally, the machine-readable code, which provides information that helps search engines and other computer programes automatically identify the licence details.

Like the Free Software movement, Creative Commons provided a robust legal framework for the Open Culture Movement. This solidified the idea that information should be more open and shareable. Furthermore, CC licences have catalyzed the growth of Digital Archives, with platforms like Flickr, SoundCloud, and YouTube hosting millions of images, audio recordings, and videos available for reuse, thus creating a vast public repository of digital content.

In summary, Lawrence Lessig's Creative Commons successfully extended the principle of "freedom" from the Free Software movement into the creative world. CC has fundamentally redefined the sharing of knowledge and art in the digital age, making information more accessible and freer. While allowing creators to retain control over their works, CC simultaneously facilitates wider participation and reuse, balancing proprietary rights with public access.

In summary, Lawrence Lessig's Creative Commons extended the principle of "freedom" from the Free Software movement into the creative world. CC has redefined the sharing of knowledge and art in the digital age, making information more accessible and freer. While allowing creators to retain control over their works, CC simultaneously facilitates wider participation and reuse.

NOTES

Lawrence Lessig (Lester Lawrence Lessig) is a prominent American academic and legal scholar. He has made significant contributions to areas such as cyber law, intellectual property, and economics. In particular, he has deeply studied copyright laws in the digital age and their societal impact. A former Professor at Harvard University Law School, he has also served as a faculty member at prestigious institutions, including Stanford University and the University of Chicago. A strong advocate for Free Culture, Lessig has continuously argued for a world where knowledge and culture are accessible to everyone. His writings and lectures on the operation of copyright in digital media have had a profound influence on the international community. The viewpoints he put forward through Creative Commons are closely aligned with the fundamental ideas of the Free Software movement.

Aaron Swartz (1986-2013) was an American computer programer, writer, internet activist, and a towering figure in the fields of Open Access and free knowledge, often described as a prodigy in the computing world and a tragic hero among internet activists. Swartz played a decisive role in the formation of Creative Commons and the creation of its technical foundation.

Swartz was instrumental in the technical design behind Creative Commons licences. He was key in designing the computer codes that helped embed the licences easily on the web and make them machine-readable. He made fundamental contributions to technically enable CC licences, which aimed to legally simplify the sharing of knowledge. More than just a programmemer, Aaron Swartz was an activist who firmly believed that knowledge should be shared freely. His perspective aligned perfectly with Creative Commons' goals. His fundamental approach was to make knowledge accessible to everyone by removing legal and technical barriers.

Swartz, who co-authored the web feed format RSS 1.0 (Rich Site Summary/Really Simple Syndication), which helps deliver new website information quickly to users, had a deep understanding of web standards at the age of fourteen. This enabled Swartz to make Creative Commons licences effective in the web-based world.

Founders of Creative Commons, including Lawrence Lessig, referred to Aaron Swartz as one of the project's "earliest architects." His technical expertise and passion for free information helped shape Creative Commons into its current form. Swartz was also a co-founder of the Open Library and the prominent social media platform Reddit. The legal troubles that followed his efforts to make paywalled academic papers freely available to the public tragically led to his suicide at the age of twenty-six.

The chain of events began in 2010 and 2011, when Aaron Swartz used the MIT network to download millions of articles from the academic journal database and the large digital library platform JSTOR (Journal Storage) in a massive download. His goal was to make these academic papers freely available to the public. Subsequently, US federal prosecutors initiated aggressive legal action against him, charging him with multiple criminal counts, including computer fraud and unauthorized access to a computer. At the time, these charges carried a potential sentence of up to 35 years in prison and heavy fines. Although JSTOR reached a settlement with Swartz and dropped the civil cases, the prosecution maintained a hardline stance on the criminal case. Believing he had done nothing wrong and that his actions were not illegal, Swartz refused to plead guilty. The prolonged legal battles, the threat of years of imprisonment, and clinical depression pushed Aaron Swartz into severe mental stress. Under extreme pressure, Swartz took his own life at the age of twenty-six. Swartz's tragic death intensified discussions about the flaws in computer laws and the free availability of knowledge.

Open Culture Movement

The Open Culture Movement is a social movement that encourages the free sharing of knowledge and creative works. It is an approach that opposes the monopolization of knowledge and advocates for the dissemination of cultural and creative resources to reach a wider audience. The philosophies of thinkers like Richard M. Stallman and Lawrence Lessig inspired this movement. The Open Culture Movement argued that the concept of the four freedoms for users in computer code, as put forward by the Free Software movement, could be applied not only to software but also to all cultural creations, including art, music, and literature.

Creative Commons licences provided a practical framework for the Open Culture Movement. Creative Commons introduced the "Some Rights Reserved" licence as an alternative to the traditional "All Rights Reserved" approach for creative works. This allowed an artist or writer to easily specify which freedoms others could have in using their creations. Museums, libraries, and other institutions widely use Creative Commons licences to make their collections available to the public. The Open Culture Movement played a pivotal role in extending the concept of freedom, which originated in the technology sector with the Free Software movement, to all cultural spheres through the use of Creative Commons licences.

CHAPTER SIX

Free Software and Open-Source Software

The terms 'Free Software' and 'Open-Source' are often used interchangeably and have similar meanings. Most Open-Source software falls under the broader category of Free and Open-Source Software (FOSS). While both terms generally refer to the same type of software, they differ in their core concepts, approaches, and objectives. Understanding these distinctions provides a deeper insight into how FOSS works and its societal impact.

The Four Fundamental Freedoms: The Core of Free Software and Open-Source

Both Free Software and Open-Source Software emphasize making source code available to everyone and granting the right to modify it. Both approaches grant users four freedoms: to use, study, modify, and distribute the software. These freedoms enable users to participate in software development. Open access to source code also facilitates inspection and error identification. This contributes to improved security, reliability, and transparency. However, their main objectives differ, creating a profound philosophical and practical divide.

Free Software: The Ethical Imperative of Freedom

The Free Software Movement, led by Richard M. Stallman and the Free Software Foundation, primarily represents an ethical and political

struggle. The declared goal of the Free Software Movement is to grant users of the software four fundamental freedoms. They consider these freedoms as sacred as freedom of speech. Here, "Free" is not used in the sense of "no cost," but in the sense of Freedom. The Free Software Movement argues that proprietary software is inherently unethical because it denies users these freedoms, effectively dividing and conquering users by keeping the software secret and unchangeable. The focus is on the user's moral rights. To avoid the confusion arising from the word "Free" also meaning "no charge," the term "Libre Software" is sometimes used, especially in non-English languages.

Key Features and Emphasis of Free Software:

- User Freedom as the Primary Goal: The most important thing is to ensure that computer users have control over their computers. They view this as an issue of justice and digital rights.
- Preventing Proprietary Software: To prevent software from becoming the monopoly of a few. This is because it can become a means for software creators to exert power over users.
- Ethical and Political Arguments: The central themes of the Free Software Movement are ethics, social justice, and the political significance of software.
- GNU General Public Licence (GNU GPL): According to its core provision, "Copyleft," if anything new is created from software under this licence, it must also be released under the GPL licence. This ensures the same freedom for the new software and prevents the creation of proprietary versions.

Open-Source: A Practical Approach to Software Development

The Open-Source Initiative (OSI), established in 1998, represents a different approach. OSI emphasizes a pragmatic, engineering-focused methodology. They emphasize the superiority of the open development model in terms of technical quality, stability, innovation speed, and cost reduction. While Open-Source licences guarantee the same four freedoms as Free Software, the primary motivation is *not* an ethical or moral obligation, but rather technical and economic benefits. The term "Open-Source" was deliberately chosen to appeal to the business world by highlighting efficiency and collaboration,

rather than the potentially confrontational, political term "Free." The focus is on *how* the software is built.

Key Features and Emphasis of Open-Source:

- Emphasis on Development Methodology: Open-Source prioritizes the collaborative, transparent approach to building software. They argue that making code publicly available can create better, more reliable, and more secure software.
- Business Advantages: Supporters of Open-Source often highlight its benefits for businesses. These include lower costs, greater flexibility, faster innovation, and the avoidance of being dependent on a single company.
- Variety of Licences: Although many Open-Source licences are also Free Software licences, the Open-Source umbrella encompasses a wider range of licences. Some of these are simpler and less restrictive. For example, the MIT and Apache licences do not have the strict Copyleft provisions of the GPL.
- "Open" Means "Open for Business": The "Open" in Open-Source often refers to transparency, availability, and a willingness to collaborate with businesses. This attracts commercial entities.
- Technical Superiority: They argue that open development enables more people to inspect and improve the software, resulting in higher-quality products.

Free Software: Open-Source Software Main Differences

Main Goal	User freedom, ethical imperative	Practical benefits of the software development methodology
Motivation	Users' ethical and political rights	Business advantages, technical excellence
Main Emphasis	Freedom to use, study, modify, and distribute	Emphasis on open approach, collaboration, quality, and innovation
Stance on Proprietary Software	Seeks to prevent proprietary control	Can work alongside or be used within proprietary software
Common Licences	GNU GPL (strong copyleft)	MIT, Apache, BSD, GPL (including weaker GPL variants)
Founders/Key Figures	Richard M. Stallman	Bruce Perens, Christine Petersen, Eric S. Raymond

The Open Approach in Open-Source Software Development

Whether it is Free Software or Open-Source Software, the fundamental principle underlying both is the open development methodology. This means that the process of building the software, including the changes being made to it and who is working on it, is transparent and understandable to anyone. This is not a secret project; it is an open and transparent process.

This open approach is made possible by some key tools and platforms:

- **Git:** Git is a crucial software system that meticulously records every change made to software code during development, allowing multiple developers to work on the same code simultaneously. It can be called a digital "dairy of change" For example, this is like several authors collaborating on a book, where the edited parts, corrections, and additions made by each author are accurately recorded and then merged to create a complete book. Git is a Version Control System. That is, it's a system that accurately records every change made to the software code, allows easy rollback to older versions, and enables multiple people to work together on the same project. The Git system can also be used to manage and keep software code privately, without making it public.

- **GitHub and GitLab Platforms:** These websites, powered by Git, are public spaces where software developers can share code and collaborate with others worldwide. It's like having a shared online office room where authors can collaborate on a book and store their work. GitHub, GitLab, and others are very popular online platforms for storing Git repositories (where Git code is kept). In these projects, methodologies such as DevOps (combining Development and Operations) are used to build software faster and more efficiently. As part of this, processes such as Continuous Integration/Continuous Deployment (CI/CD), which automatically test and deploy code changes, are common. This also enables developers from around the world to collaborate on a single project.

On such open platforms, new ideas and code contributions are accepted from anyone. This promotes diverse perspectives and helps improve the software more quickly, driving innovation. The freedoms

granted by both philosophies are enforced using copyright law through specific licences. These licences, while legal documents, determine the relationship between the creator and the user.

The GPL Licence: "Copy Left" or the Protector of Freedom

The GPL (GNU General Public Licence) is a "Copyleft" licence. The term "Copyleft" is used as an antonym to "Copyright" and refers to a form of "copy abandonment" or relinquishment of exclusivity. While copyright helps the owner retain rights over a work, copyleft helps extend those freedoms to others as well.

The GPL is sometimes referred to as a "Viral Licence." This is because if you create new software under this licence or modify existing GPL software, the new software incorporating those changes must also be released under the GPL licence. Its code must also be made available to everyone.

For example, imagine we are making a cake using a specific recipe. If this cake recipe is under the GPL licence:

- Anyone can make the cake using the original recipe.
- They can study how the recipe was made.
- They can modify the recipe (add new flavors, change ingredients).
- They can make the cake and give it to others (and can even sell it for a price).

However, there is one condition: if we make any changes to this recipe, create a new cake, and give the new recipe to someone else, the modified new recipe must also be provided under the GPL licence. That is, the new recipe must also be usable, studyable, modifiable, and shareable by anyone. The goal is to ensure that the software's freedom is always preserved. While the GPL allows changes to Free Software, it prevents those changes from being made proprietary (private). The core of the GPL is: "Just as you receive all these freedoms, the same freedoms must be available to others."

LGPL: More Permissive Copyleft Licence

While the GPL is a strong Copy Left licence, the GNU Lesser General Public Licence (LGPL), also released by Richard M. Stallman's Foundation, is another Copyleft licence. It is slightly more "permissive" than the GPL. When using LGPL code, the LGPL

portion—including any modifications made to it—must remain Free Software. Additionally, users of the software must be able to rebuild it using a different version of the LGPL library (a collection of pre-written code, functions, and conditions).

The GPL is like strong glue. It firmly attaches the code to the GPL, meaning that wherever this code is used, it must also be licenced under the same terms as the GPL. However, the LGPL is like a slightly looser glue. It allows the code to be used in proprietary projects, but the LGPL portion must remain free and be replaceable if needed.

In summary, understanding the differences between the GPL and LGPL licences clarifies how software freedom is protected and how varying levels of openness can impact both software development and business models. By selecting the appropriate licence, developers can align their projects with their values and goals, whether they are focused on preserving freedom or seeking broader collaboration.

In short, the choice between GPL and LGPL depends on the project's requirements and whether it should permit the code to be used in proprietary software.

The main difference between the GPL and LGPL lies in how they handle linking with other software:

- GPL: Strong Linking: If GPL code is linked with a project, the entire project must be released under the GPL licence. This is known as its viral nature. Therefore, GPL code cannot be used in a Proprietary Software project.
- LGPL: Loose Linking: LGPL code is primarily used for software libraries. It allows these LGPL libraries to be linked with proprietary software. This avoids the need for the entire piece of software to be made Open-Source.

MIT, Apache, and BSD Licences: "More Permissive"

Licenses such as the MIT, Apache, and BSD Licence. These are referred to as "Permissive Licence." They do not have the strict Copyleft conditions of the GPL.

We can look at the cake example again here. If we make a cake using a recipe that is under an MIT or Apache licence:

- We can make the cake using this recipe.
- We can study how the recipe was made.

- We can modify the recipe.
- We can make the cake and give it to others (and can even sell it for a price).

However, unlike the GPL, if you make any changes to this recipe, create a new cake, and give the modified recipe to someone else, the new recipe can be provided under any other licence. It is permitted to keep it private or proprietary. This means there is no obligation to share the modified recipe with others, nor does it have to remain free.

Specific Features of MIT and Apache Licences:

- **MIT Licence:** This is a very simple licence. It grants anyone permission to use, modify, distribute, and commercially use the software. The only condition is that a copy of the MIT licence must be included with the software. Simply put, the MIT licence says, "You can do anything with this code, but just make sure this licence, which states I created it, is present."

- **Apache Licence 2.0:** The Apache Licence has slightly more conditions than the MIT licence. It grants permission to use, modify, distribute, and use the software commercially. Its main conditions include providing a copy of the licence, clearly stating the changes made, and complying with certain provisions regarding patent rights.

- **BSD Licences:** BSD (Berkeley Software Distribution) Licences are another group of licences widely used by many Open-Source projects. They also fall into the Permissive Licences category. This means they do not have the strict "Copyleft" provisions like the GPL. BSD licences primarily come in different versions, such as the 3-Clause and 2-Clause licences. They generally allow code to be used widely and modified. There are only minor differences in the conditions for redistribution. Simply put, if you create your own software using code under a BSD licence, you can keep that software proprietary (Closed source). BSD licences grant considerable freedom to use and modify the code, which is why they are considered the Open-Source licences that are closest to proprietary software.

Main Differences Between Various Licences

GPL	Strong Copyleft	Yes (Full)	Modified software must also be under the same GPL licence; mandatory sharing of source code.	Software prioritizing Open-Source freedom	No	Strict; generally incompatible with non-GPL licences
LGPL	Weak Copyleft	Yes (Limited)	Allows linking with proprietary code; only the library code must remain LGPL.	Libraries allowing partial proprietary usage	No	More liberal than GPL
MIT Licence	Permissive	No	Wide usage, modification, and distribution with attribution.	Flexible projects	No	High compatibility with most licences, including proprietary
Apache Licence 2.0	Permissive	No	Wide usage requires attribution, patent grant, protection for contributors.	Projects requiring legal clarity	Yes	Compatible with most licences
BSD Licence	Permissive	No	Wide usage, minimal restrictions, requires attribution; 3-Clause adds "no endorsement."	Simple and flexible software	No (2- Clause), Yes (3- Clause)	High compatibility with most licences, including proprietary

The Unified Vision of FOSS

Although the words 'Free Software' and 'Open-Source' may seem similar on the surface, a deeper examination reveals distinct philosophies behind them. Free Software takes a strong ethical stance on user freedom, while Open-Source takes a more pragmatic approach to software development. Both have made huge contributions to sharing software and collaborating on new innovations. These two approaches have created a vibrant software ecosystem that empowers users and advances technology. Understanding the differences between them helps to more accurately grasp the rich history and diverse goals of the Free and Open-Source Software movements. The open approach of the Free and Open-Source Software movements helps to make the future growth of technology a subject worthy of study.

NOTES

Bruce Perens is a computer programer and a strong advocate of the Open-Source Movement. He played a crucial role in defining the Open-Source concept (Open-Source Definition) and introducing the term "Open-Source" to the world. A former leader of the Debian Project, Perens has been associated with numerous Open-Source projects like BusyBox. He was a Systems Programer at Pixar Animation Studios and now primarily works as a consultant on intellectual property matters, as well as serving as the Chief Executive Officer (CEO) of companies developing new digital wireless communications technologies.

Christine Peterson is the co-founder of the Foresight Institute. She is known as one of the people who proposed the term "Open-Source" for software. Christine, who holds a degree in Chemistry from MIT, is actively involved in discussions about the future of technology and in fields such as nanotechnology.

Eric S. Raymond known as ESR, is famous as an American software developer, Open-Source software advocate, and author. His 1997 essay and 1999 book, *The Cathedral and the Bazaar*, provided crucial insights into the Open-Source development model. He also played a key role in editing *The New Hacker's Dictionary* (1996). He focuses on computer programing and writing.

These three individuals, along with others, co-founded the Open-Source Initiative, which leads efforts to approve Open-Source licences and promote Open-Source principles.

Viral Licence

While the GNU General Public Licence (GPL) is frequently described in technical and legal circles as a "Viral Licence," it is important to note that this terminology has a controversial history. The term was originally popularized by critics of Free Software to suggest that the GPL's Copyleft requirement, which mandates that any software incorporating GPL-licensed code must also be released under the GPL,functions like a biological virus that "infects" proprietary code.

Proponents of the movement, including the Free Software Foundation (FSF), generally avoid this term as it implies a negative or unwanted spreading of the license. Instead, they prefer terms such as "Protective Licence" or "Reciprocal Licence". From their perspective, the GPL acts as a legal safeguard that ensures the freedoms of "use, study, modify, and share" are reciprocated and preserved for every subsequent user, preventing the software from being enclosed in a proprietary "black box".

CHAPTER SEVEN

Open Access Publications: Gateways to Knowledge

The concept of Open Access represents a natural extension of the Free Software philosophy; a movement committed to dismantling the monopolization of knowledge and restoring the freedom to share ideas. This chapter revisits the principles, evolution, and global expansion of Open Access, while highlighting the recent policy developments and Indian initiatives that continue to shape its trajectory.

Copyright restrictions and high prices often pose significant barriers to the accessibility of knowledge and information. To overcome these challenges, Open Access publications have emerged as an alternative, drawing inspiration from the Free Software philosophy. By making academic publications freely available online, the Open Access model removes the barriers of price and copyright.

What is Open Access?

Unlike traditional publications, Open Access publications are digital. They are available online for free and are free from copyright and licensing restrictions. The main elements of Open Access are the author's or copyright holder's consent and the availability of technology for digital publication.

Academic journals typically do not pay compensation to authors. Therefore, when academics provide their papers as Open Access, they do not incur financial loss. Furthermore, Open Access is perfectly compatible with the Peer Review process. The importance of peer review in ensuring academic quality is immense. Just as authors of journal articles provide their works for free, the editors and referees participating in the peer review also provide their services for free. The Open Access movement aims to make knowledge accessible to everyone.

Open Access Journals and Archives

The primary ways to deliver research papers into Open Access are through Open Access Journals, Archives, and Repositories. Each of these has its own specific characteristics. Open Access Journals publish research papers that have passed through the peer review process. Archives and Repositories make research findings available without conducting peer review themselves. These may contain pre-prints (research papers before peer review), post-prints (research papers after peer review), or both.

Archives can be organised by institution (university, laboratory) or subject area (physics, economics, social sciences). Consent from others is generally not required for archiving, and most journals allow archiving post prints. By utilizing the metadata protocol of the Open Archives Initiative (OAI), various archives can be linked, and information can be easily discovered and accessed. Open-source software is available to build and maintain Open Access archives. The use of these is increasing. The operating cost of an archive is very low; typically, only a small amount of Server Space and the service of technical experts are required.

Financial Models of Open Access Journals

Open-access journals cover the costs of making peer-reviewed, approved content freely available through various methods. The primary costs for publication include peer review, manuscript preparation, and Server Space. Open-access journals manage costs similarly to television and radio stations. Those interested in disseminating the content cover the necessary publication costs in advance. This helps make the content available for free to anyone with digital reading technologies.

Often, the full or subsidised publication costs are obtained from the university where the author works, the institution where the study and research are conducted, or the relevant professional society. Some Open Access publishers charge Article Processing Charges (APCs) for accepted articles. This fee must be paid by the author or the author's sponsor (employer, funding agency). However, this fee is often waived for authors facing financial difficulties.

Open Access journals with institutional subsidies typically do not charge processing fees. If revenue is generated from other publications, advertisements, or related support services, Open Access journals can operate with minimal subsidies or fees. Some institutions and consortia arrange fee waivers. Certain publishers completely waive fees for researchers at institutions that opt for annual membership.

Peer Review and Quality: Concerns and Reality

Although the benefits of Open Access are clear, there are some doubts and controversies about the quality of research published in Open Access journals and their peer-review processes. Many scholars believe that robust peer review does not occur in Open Access journals, and therefore, the quality is low.

However, closer inspection reveals that these criticisms are unfounded. Open-access publishing makes a strong effort to ensure the quality of scientific publications. Open-access journals follow the same traditional peer-review process. Furthermore, Open Access facilitates collaborative peer review. Open Access provides a platform for members of the scientific community and the public to engage in mutual discussion and review of articles. Since reviewers have quick access to publications related to various scientific subjects, there is an opportunity to enhance the quality of articles published in Open-Access journals. Therefore, Open Access not only facilitates the dissemination of scientific knowledge but also plays a crucial role in ensuring its quality and integrity.

Speed and Transparency: In Open Access Peer Review

The peer-review process, followed by publication in print, is time-consuming and slow. This is not at all suitable for the current era of knowledge explosion. Often, by the time a paper is published after peer review, its relevance may have been lost. However, in the Open Access system, peer review is conducted online, with the draft of the

paper published in advance, allowing the public to provide feedback. This allows the draft paper to be made available earlier and the peer review to be completed without delay, enabling its publication in the journal. Experts conducting peer reviews publish their opinions online. Typically, the peer review team consists of two reviewers and a statistician. Since it is an online publication, the added advantage is that the usage and Impact Factor of the papers published in Open Access journals can be obtained with greater accuracy. Information on the citation of papers (Citation Index) can be quickly obtained, not only in prominent journals but also in other journals.

The Possibilities and Diversity of Open Access

The permission to reproduce published information and the method of free and open access are highly debated topics between the supporters and opponents of Open Access publishing. Open Access publishing is gaining traction today as the fastest solution to the obstacles to making information published online available. Publishers and researchers alike are actively discussing the advantages and disadvantages of Open Access.

The diversity of knowledge media, the increasing volume of information, and the publication and dissemination of information have become challenges for learners and researchers. Information availability is crucial to research. Correct repositories and methods for recording knowledge in a modern way are essential. As the number of research papers in each subject increases, Open Access publications make them freely available to the scientific community.

Various possibilities for knowledge accessibility are being utilized based on Open Access. Videos that can be downloaded and used for free to assist learning and knowledge acquisition are available on YouTube. Many textbooks that can be made freely available are being published by various universities and publishers. Previously, only older editions were published using the Open Access method. However, they have recently become available just a few months after publication.

Problems of Traditional Publishing and the Importance of Open Access

Once published in a journal, the author typically receives a fixed number of copies of the paper, as stipulated by copyright law. This

is not the full journal, but only a limited number (often ten) of PDF copies of the article. The author is not even entitled to make copies of these. If additional copies are required, the journal must be purchased in its complete form. The author is denied permission to republish the article until the copyright period expires. Consequently, researchers effectively lose the right to their papers detailing their research findings.

Furthermore, institutions like universities, which provide financial support for preparing research papers, are often compelled to purchase the journals in which their papers, written at their expense, were published. This situation, where the same item incurs two types of expenses, is described by economists as "Double Dipping".

The publishers of prominent journals are considered the elite of the academic sphere. Prices are charged according to the journal's prestige. This price increases annually to an unaffordable extent for many institutions. As a result, most institutions are unable to purchase the best journals. For effective knowledge exchange, academic papers need to reach as many people as possible. However, copyright laws and the exorbitant prices of journals and books create obstacles to the dissemination of academic knowledge.

Different Types of Open Access

Golden Open Access: This is a model in which articles are available to anyone to read, download, and use freely immediately upon publication. Here, the authors (or their institution) typically must pay a fee, known as an Article Processing Charge (APC), to the publisher. The publisher is responsible for the peer review, editing, publication, and promotion of the articles.

Green Open Access: This is a method in which the author self-archives their research paper in an Open Access repository (typically institutional, subject-specific, or personal websites). The full article is often made available after a fixed period following publication in a journal (Embargo Period). No specific fee is charged for publication. This is usually either the pre-print (the version before peer review) or the post-print (the version after peer review but without the publisher's formatting).

Hybrid Open Access: This is a model in which a specific article in a journal that traditionally operates on a subscription basis becomes Open Access upon payment of a fee. This means that while some articles

in a journal are freely available, other articles require a subscription. This is also criticized as "Double-Dipping" because publishers collect both subscription fees and Article Processing Charges simultaneously.

Bronze Open Access: In this category, papers are made freely available for reading on the publisher's website, but they lack a clear Open Licence (e.g., a Creative Commons Licence). This is often applied in situations where articles in subscription journals are made free for a specified period (as part of a promotion or other reason). Since the rights for reuse or distribution are unclear, and free access can be withdrawn at any time, this is not considered full Open Access.

Diamond Open Access: This is an Open Access model in which content is made fully available for free, with no fees charged to authors or readers. The funding for their operation comes from various sources, including universities, academic institutions, government grants, volunteers, and crowdfunding. This makes access to knowledge equitable and unlimited.

Open Content Project: The 'Open-Source' Approach for Content

Inspired by the Free Software movement, the effort to apply 'Open' principles to creative works other than software took shape through the concept of 'Open Content'. This approach aims to simplify and make copyright laws more participatory for digital content, including writings, images, audio recordings, and videos.

One of the chief architects of this idea was Professor David Wiley, who first used the term 'Open Content' in 1998. Wiley had a particular interest in how Open Content could help reduce learning costs and improve educational standards. Following the model of Free Software licences like GPL, he sought to formulate licences for content. As part of this, he published the Open Content Licence (OCL) in 1998. Collaborating with individuals, including Eric Raymond, who popularised the 'Open-Source' concept in the software world, and prominent technology publisher Tim O'Reilly, Wiley released the Open Publication Licence (OPL) in 1999. This was considered an improved version of the Open Content Licence. Eric Raymond's famous book, *"The Cathedral and the Bazaar"* (O'Reilly Media: 1999), was published under the Open Publication Licence.

However, these early licences had some legal shortcomings. When Creative Commons Licences entered the scene with superior legal

design, created with the help of lawyers, David Wiley ended the Open Content Project in 2003 and began serving as the Director of Educational Licences at Creative Commons. Wiley recommended that users adopt Creative Commons licences instead of the Open Content Project's licences.

In summary, the Open Content Project was an important precursor to Creative Commons Licences. The early efforts by David Wiley, Eric Raymond, and Tim O'Reilly to extend Free Software principles to non-software creations laid a strong foundation for the legal frameworks governing content sharing in the digital age.

Open Course Ware: The First Steps of Open Education

Open Course Ware (OCW) refers to universities publishing their course materials online to make them freely available to the world. This was a precursor to the broader movement known as Open Educational Resources (OER). The essence of OCW is to make all important information related to a course—such as curricula, lecture notes, assignments, exam questions, and reference materials—available for free in digital form.

The Massachusetts Institute of Technology (MIT) initiated the OpenCourseWare movement. In 2001, MIT announced the revolutionary decision to make the study materials from all its courses freely available online. MIT OpenCourseWare officially launched in 2002. These moves by MIT, one of the world's leading technological institutions, have created a significant global impact. By providing free access to world-class educational resources for millions of people, MIT established a model for democratising knowledge. MIT OpenCourseWare served as an inspiration for many other universities to launch similar OCW projects.

In the field of Open Education, the OpenStax initiative is one of Rice University's main contributions. This is a non-profit initiative started by Rice University in 2012. The main objective of OpenStax was to make high-quality and freely available Open Textbooks available to students who must pay high prices for traditional textbooks. OpenStax provides peer-reviewed textbooks available under open licences in PDF, web, and print formats at a low cost. Going one step beyond courseware, this initiative has significantly reduced educational costs by making complete textbooks available under open licences. The crucial role played by MIT and Rice University in the early advances

of the OCW and OER movements was an important step toward making educational materials accessible to everyone.

Open Educational Resources

Open Educational Resources (OER) are teaching, learning, and research materials that are freely available and licenced under open licences. These may include textbooks, learning modules, video lectures, assignments, quizzes, curriculum, and other learning materials. Users are granted free permission to use, modify, distribute, and reuse these resources. The OER movement emerged with the goal of making education more accessible, reducing costs, and enhancing quality.

David Wiley's contributions through the Open Content Project were crucial in providing a legal framework for the OER movement. He consistently argued about the need for open licences and designed the Open Content Licences. Salman Khan, the founder of Khan Academy, played a pivotal role in making free education accessible to a large segment of students through video lessons. The collective effort of many educational institutions, teachers, researchers, and non-profit organisations working in this field has made OER a comprehensive resource.

The United Nations Educational, Scientific, and Cultural Organisation (UNESCO) has played a major role in providing global legal validity and recognition to the Open Educational Resources movement. The concept of 'Open Course Ware' was first officially defined as 'Open Educational Resources' in a forum organised by UNESCO in 2002.

The 2012 Paris OER Declaration put forward global guidelines for developing, using, and promoting OER. The Paris Declaration recommended that all countries formulate OER policies. The most important UNESCO document on OER is the 2019 UNESCO OER Recommendation. The recommendations by UNESCO, unanimously adopted by member states, are the first global-standard recommendations to support the creation, use, reuse, and dissemination of OER. UNESCO puts forward five areas of action: building OER capacity, developing supportive policies, ensuring inclusive and equitable quality OER, fostering sustainable OER models, and facilitating international cooperation.

UNESCO's efforts have helped OER gain recognition as an educational principle worldwide, provided policy support to governments, and

strengthened the global movement to make educational materials freely available to everyone. OER plays a major role in achieving the UN's Sustainable Development Goal 4 (SDG 4), which is to ensure inclusive and equitable quality education for all.

Open Access Initiatives and Standards

Numerous global initiatives have already been established to implement Open Access standards and guidelines. The main ones include

The Budapest Open Access Initiative (BOAI) was a crucial milestone for the Open Access movement. The BOAI was organised by the Open Society Institute (Open Society Foundations: OSF since 2020) in February 2002. The BOAI first proposed an official definition and fundamental principles for the Open Access concept, which involves making research papers and studies freely available online to everyone. This initiative provided clear direction for the Open Access movement and became a great inspiration for its global expansion.

The Glasgow Declaration (The Glasgow Declaration on Libraries, Information Services, and Intellectual Freedom) was made on August 19, 2002, in Glasgow, Scotland, by the International Federation of Library Associations and Institutions (IFLA) Council. The primary objective of the declaration is to uphold and promote Intellectual Freedom, one of the most important principles for libraries and information services.

Berlin Declaration (Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities) is another significant document in the Open Access movement. The Berlin Declaration was issued in October 2003 at an international conference on the communication of knowledge in science and the humanities, organised by the Max Planck Society in Berlin, Germany. The declaration emphasised the importance of making human knowledge and cultural heritage globally available online. The Berlin Declaration asserts, "Our mission to disseminate knowledge remains half-finished if information is not widely and easily accessible to society." The Berlin Declaration aims to make scientific research results and cultural information accessible to everyone by harnessing the potential of the internet.

The Berlin Declaration outlines two primary conditions for Open Access contributions. Accordingly, authors and rights holders must grant all users free, irrevocable, worldwide access to the knowledge.

Furthermore, the licence must permit copying, using, distributing, publicly displaying, transforming the works into other formats, and distributing them. The full version of the work and all supplementary materials must be deposited in at least one online Repository in an appropriate electronic format. The declaration called upon researchers to publish their studies using the Open Access model and for cultural institutions to support Open Access by making their collections available online. The Berlin Declaration provided a new direction for the Open Access movement, motivating universities and research institutions worldwide to adopt Open Access policies.

The United Nations World Summit on the Information Society (WSIS) was a landmark global conference that profoundly influenced the future of the information society. It was held in two phases, in 2003 and 2005. The first phase took place in Geneva, Switzerland, in December 2003, and the second in Tunis, Tunisia, in November 2005. The summit was organised under the auspices of the United Nations, with the International Telecommunication Union (ITU) playing a leading role.

The summit was designed to reduce the digital divide and ensure that the benefits of information and communication technologies are accessible to everyone equally. Key topics discussed included making information universally accessible, developing policies on Internet governance, ensuring cybersecurity, and exploring ways to effectively use technology for social development. The primary objectives of the summit were to facilitate social and economic development through the use of information technology, promote the free flow of knowledge, and foster an inclusive, participatory information society. The summit also presented a blueprint for a global information society, emphasising the principles of Open Access and Free Software.

The British Parliament Committee Report published by the United Kingdom's House of Commons Science and Technology Committee in July 2004, gave a major boost to the Open Access movement. The report, titled "*Scientific Publications: Free for All?*", strongly recommended that research findings produced using public funds should be made freely accessible to everyone. The committee noted that the high cost of academic publications and limited access to them were hindering research progress. Therefore, the report suggested that all British universities establish Open Access Repositories and that researchers deposit their publications in them. It also urged funding

agencies to promote Open Access publishing. This report served as a model for governments and research institutions worldwide in formulating their Open Access policies.

The Bethesda Statement on Open Access Publishing was a major milestone in the Open Access movement. The declaration was made at a conference held in Bethesda, USA, in June 2003. The conference, which brought together leading figures in biomedical research, put forward practical recommendations to make research papers freely accessible to all.

The Bethesda Statement proposed two main pathways for contributing to Open Access: first, ensuring that articles are made freely available immediately upon publication in Open Access journals; and second, encouraging researchers to self-archive their accepted manuscripts in institutional or subject-area repositories. The statement emphasised the importance of rapidly and widely sharing research findings. It also supported the principle that research funded by public money should be accessible to the public. Alongside similar initiatives such as the Budapest Open Access Initiative, the Bethesda Statement provided clear direction for the Open Access movement and significantly contributed to its global expansion.

The OECD Declaration on Access to Research Data from Public Funding marked a significant advance in the Open Access movement toward making research outcomes publicly available. Issued in 2004 by the Organisation for Economic Co-operation and Development (OECD), the declaration further expanded the scope of Open Access publishing. It is recommended that not only research papers but also research data generated through public funding should be made freely accessible.

The declaration emphasised that data sharing is essential to ensure transparency in research and to enhance the reproducibility of studies. It noted that the exchange of research data between countries would promote scientific discovery, technological progress, and innovation. While acknowledging the need for restrictions related to personal privacy, intellectual property rights, and national security, the declaration encouraged OECD member countries to develop guidelines for unhindered digital access to research data.

Coalition S is one of the most influential global initiatives in the Open Access movement, launched in 2018. It is an alliance of major research

funding organisations and agencies from around the world. The coalition's primary goal is to make all publicly funded research results fully and immediately accessible to the public.

Recent years have seen further consolidation of Open Access frameworks. Plan S, launched by Coalition S, is now fully operational, mandating that all research funded by participating agencies be made available immediately in open-access formats. The plan's Rights Retention Strategy ensures that authors retain copyright while granting broad reuse rights under open licences. In 2023, UNESCO and the European Commission renewed their support for Diamond Open Access models, emphasising sustainability through institutional and governmental funding.

Coalition S introduced a strict mandate requiring that research papers arising from projects it funds be published immediately in Open-Access journals. To implement this, the coalition launched the Plan S initiative in 2018. Under Plan S, effective January 1, 2021, all publications resulting from funding provided by Coalition S members must be fully Open Access. This initiative has brought about significant changes to traditional subscription-based publishing systems, further strengthening Open Access publishing practices worldwide.

Recent years have seen further consolidation of Open Access frameworks. Plan S, launched by Coalition S, is now fully operational, mandating that all research funded by participating agencies be made available immediately in open-access formats. The plan's Rights Retention Strategy ensures that authors retain copyright while granting broad reuse rights under open licences. In 2023, UNESCO and the European Commission renewed their support for Diamond Open Access models, emphasising sustainability through institutional and governmental funding.

Major Open Access Journals

In the ever-expanding field of Open Access publishing, numerous online initiatives have been launched across various disciplines to make research papers and related materials freely accessible:

Multidisciplinary:

- PLOS ONE (Public Library of Science ONE): Noted for its strong peer-review system.
- Scientific Reports: Part of the Nature Portfolio.

- BioMed Central (BMC): A collection of life and medical science journals under Springer Nature.

Biology and Medicine:

- eLife: Publishes cutting-edge research in modern biological and medical sciences.
- The New England Journal of Medicine (NEJM): Although not entirely Open Access, it makes a significant portion of its content freely available.
- Hindawi: Publishes numerous medical journals.

Humanities and Social Sciences:

- Frontiers in Open Humanities
- PLOS ONE also publishes journals in these subject areas.

Physics:

- New Journal of Physics: Jointly published by the German Physical Society and the Institute of Physics.

Mathematics:

- Acta Mathematica
- Software Research:
- Journal of Open-Source Software

Major Sources Providing Information on Open Access Journals in Scientific Fields:

- Directory of Open Access Journals (DOAJ)
- Open Access Scholarly Publishing Association (OASPA)
- Scholarly Publishing and Academic Resources Coalition (SPARC)

These sources also provide information about predatory or low-quality journals that are published under the Open Access label.

The PLOS Open Letter: A Milestone

In 2000, Nobel laureate and former Director of the U.S. National Institutes of Health (NIH), Harold Varmus, along with Michael Eisen and Patrick O. Brown, issued an open letter to the global scientific publishing community under the auspices of PLOS (Public Library of Science). The letter called for a fundamental change in scientific publishing and argued that research papers should be made freely accessible to the public.

They urged publishers to allow the free and unrestricted distribution of the full text of research articles. Beginning in September 2001, they announced that they would review or publish papers only in journals that agreed to make their content freely available online. The PLOS open letter had a profound impact on the scientific community, with nearly 30,000 scientists from 180 countries signing it. PLOS journals adhere to the highest standards of Open Access, making their content freely available immediately upon publication and ensuring long-term archiving of published materials. PLOS's policies and practices strongly align with the principle that research content must be permanently archived and freely accessible to the public. The PLOS letter played a pivotal role in the evolution of the Open-Access movement and in establishing PLOS as a leading Open-Access publisher worldwide.

Internet Archive: The Memory Keeper of the Digital World

The Internet Archive is a non-profit digital library established to preserve digital history and knowledge. It was founded in 1996 by Brewster Kahle. The primary mission of the Archive is to collect, preserve, and make publicly accessible various types of digital content, including web pages, books, audio recordings, videos, images, and software, at no cost.

The main projects of the Internet Archive are:

- Archive.org is the primary website of the Archive. Here, various types of content from the world's digital history are freely available. This includes audio recordings (such as music and radio shows), old movies and videos, software (especially vintage computer games), academic papers, and archived television news clips.
- Wayback Machine is the most well-known project of the Archive. It can be used to understand how old websites looked in the past, observe how they have evolved over time, and view web pages that are no longer accessible. It contains millions of "snapshots" of thousands of websites.

The Internet Archive plays a crucial role in digital preservation, helping to prevent the loss of digital information over time. Through appropriate licensing, it strives to legally archive all possible digital content.

Open Library: A Web Page for Every Book

The Open Library is another project of the Internet Archive. It is a large online initiative that aims to create "a web page for every book ever published." The Open Library was launched in 2006 by Aaron Swartz, Brewster Kahle, Alexis Rossi, Anand Giridharadas, and Rebecca Hargrave Malamud. Aaron Swartz led the initial technical design of the library.

The Open Library functions as a comprehensive catalogueue of books. The catalogueue is built using information collected from major libraries, including the Library of Congress, the largest library in the world, as well as other major libraries and individual users. Digital versions of millions of books are available here. Through a system known as Controlled Digital Lending, readers can "borrow" and read digital books for free. Just like in a physical library, only one copy of a book can be borrowed by one person at a time.

Like Wikipedia, the Open Library is a wiki-based platform. Any registered user can edit book information and add new details, thereby improving the accuracy and completeness of the data. Books in the public domain, works whose copyrights have expired, and other authorised books are available here in digital formats, including e-books and audiobooks. This service is particularly beneficial for visually impaired and learning-disabled readers.

The software of the Open Library is Open-Source, meaning that anyone can view its code and suggest improvements. The main goals of the Open Library are to make knowledge accessible to everyone and to preserve the digital collection of books. The project advances with the ambitious goal of providing comprehensive information about every book ever published worldwide on a single, centralised platform.

Open Access Initiatives in India

Recent developments in India have reaffirmed the commitment to Open Access and equitable access to knowledge. The Government of India's National Education Policy (NEP) 2020 highlights the use of Open Educational Resources (OER) and digital repositories to democratize education. INFLIBNET continues to expand its repositories, including ShodhGanga (for theses), ShodhGangotri (for research proposals), and ShodhShuddhi (for plagiarism detection).

Meanwhile, the National Knowledge Network (NKN) and Swayam Prabha satellite channels further strengthen the digital learning infrastructure. Kerala's pioneering KITE project stands as a leading example of localised open educational implementation.

In the Indian context, the publication of Open Access journals has been a significant achievement for several reasons. Many high-priced international journals are not accessible in our universities or higher education institutions. This limitation has had an adverse impact on modern research activities. Furthermore, several foreign journals often show little interest in publishing articles by Indian scholars. Considering all these challenges, numerous initiatives have been launched in India to make Indian journals and information sources freely available online.

The following are the key initiatives:

- The Indian Academy of Sciences has made its ten journals, and the National Academy of Sciences has made its four journals, freely accessible online under the Open Access model.
- The Indian Medlars Centre of the National Informatics Centre publishes 22 biomedical journals and provides online abstracts of papers from 77 Indian biomedical journals.
- The Information and Library Network (INFLIBNET) is a Government of India initiative that provides access to foreign journals for Indian universities, higher education institutions, and colleges.
- The National Information System for Science and Technology (NISSAT), under the Department of Science and Technology (DST), integrates various information sources, systems, and services into a unified network.
- The Indian division of PubMed Central (PMC India) serves as a free repository for biomedical and life science journals.
- At the national level, the Shodhganga project has been launched as a repository for research theses and dissertations.
- Several universities, following the DSpace@IIT Kanpur (IITK) model, have launched initiatives to make their research papers easily accessible to students and faculty members.
- The e-PG Pathshala platform publishes high-quality study materials for postgraduate courses.

To ensure uninterrupted access to electronic resources, the National Knowledge Network (NKN) has been established at the national level, linking educational institutions across India.

One Nation One Subscription

The One Nation One Subscription (ONOS) initiative, announced in 2023, aims to provide unified access to academic journals across publicly funded institutions. The scheme aims to provide nationwide access to major scholarly e-journals from prominent publishers across disciplines such as STEM, Medicine, Management, Social Sciences and Humanities. The UGC's Information and Library Network (INFLIBNET) centre is to act as the implementing agency for ONOS. The scheme will give 6,400 institutions across the country (including central and state universities, colleges, and research institutions) and 1.2 crore students, faculty, and researchers access to over 13,000 top journals, including global publishers such as Elsevier, Springer Nature, Taylor & Francis, and Wiley. The Anusandhan National Research Foundation (ANRF) Act seeks to boost research in higher education institutions in smaller towns with plans for central funding to support Indian authors in paying Article Processing Charges for quality Open Access journals. However, private universities have been excluded from the ambit of ONOS.

Alternative Pathways in the Struggle for Knowledge

While the fundamental principles of Open Science, which emphasise that scientific knowledge should be freely accessible to everyone, remain steadfast, the paywalls that require payment to access published content and the commercial interests that dominate the publishing sector still pose significant challenges. It is in this context that alternative platforms, aided by technology and designed to make information more widely accessible, have emerged.

Online platforms such as Z-Library, Sci-Hub (founded by Alexandra Elbakyan), and Libgen (Library Genesis) provide free access to research papers, books, and scientific information by either circumventing paywalls or through unauthorised channels. Although these platforms remain subjects of legal controversy, they highlight both the need for universal access to scientific knowledge and the limitations of existing publishing models.

For researchers in developing countries and for individuals without the backing of large institutions, these platforms play a crucial role in enabling access to knowledge. Even if not always operating within legal boundaries, these efforts reflect another dimension of the Free Software philosophy: freedom, collaboration, and sharing. Despite their controversies, such initiatives represent complex interventions in the struggle against the monopolisation of knowledge, continuing to challenge the restrictive structures that limit access to information.

Challenges Facing Open Access

Although more publishers and academic institutions are publishing Open Access journals, a significant portion of the academic community and researchers still lacks sufficient awareness of the Open Access movement, its publications, and their potential. Consequently, the opportunities offered by Open Access publishing have not yet been fully utilised.

To ensure the sustainability of Open Access publications, achieving financial stability is crucial. While several governments around the world have begun allocating more funds to Open Access publishing, the rising costs mean that funding sources still need to be expanded. Ensuring the quality of Open Access publications remains a major challenge. Some predatory journals that fail to follow recognised standards in peer review and editorial processes have tarnished the credibility of the Open Access movement.

Many Open Access journals charge authors article processing fees to cover publication costs. This shifts the financial burden from readers to writers. Such a model can create significant obstacles for researchers with limited funding, particularly those in low- and middle-income countries. Diamond Open Access journals—which charge neither readers nor authors—depend on external institutional funding, but such sources are often unstable and unsustainable.

The lack of standardised practices and coordination among Open Access repositories and archives also impedes their smooth, integrated use. Furthermore, the maintenance, upgrading, and long-term preservation of digital collections continue to present ongoing challenges.

Despite these difficulties, Open Access publications have already achieved a significant and undeniable place in the academic world by overcoming financial and technical constraints, ensuring quality and

accessibility, and challenging the traditional, commercialised print-based models that dominate scholarly communication. In the broader sense, Open Access has become central to the democratisation of knowledge. It aligns directly with the Sustainable Development Goals (SDGs 4 and 9), promoting inclusive, equitable, and innovative education and research. In an era of commercialised academic publishing, Open Access reaffirms knowledge as a public good rather than a commodity. The continued expansion of Open Access policies, repositories, and institutional mandates promises a future where learning and research transcend economic and geographic barriers.

Open Access stands as one of the most transformative movements of the digital era. By ensuring unrestricted access to scholarly and educational resources, it embodies the same principles that define Free Software—freedom, collaboration, and the collective advancement of humanity. Its evolution from early declarations to national policies signals a paradigm shift in the way society produces, shares, and preserves knowledge for future generations.

NOTES

David Wiley often referred to as the "Father of the Open Educational Resources (OER) movement," is a pioneering advocate for the free sharing of knowledge. Born in 1976, he introduced the term "Open Content" in 1998 and created the Open Content Licence (OCL), proposing that educational and creative works should enjoy freedoms similar to those of software under the GNU General Public Licence. Collaborating with Eric Raymond and Tim O'Reilly, he later developed the Open Publication Licence (OPL), which laid the groundwork for today's open licensing culture. When Creative Commons emerged in 2003, Wiley joined as Director of Educational Licences, further advancing open education. A professor at Utah State University, he continues to lead global OER initiatives promoting equitable access to knowledge. Tim O'Reilly, founder and CEO of O'Reilly Media, is a key figure in the Open-Source and Web 2.0 movements. Known for translating complex technical ideas into accessible knowledge, he helped popularise the term "Open-Source," organised the influential 1998 Open-Source Summit, and collaborated with Wiley on the OPL.

O'Reilly also coined the concept of "Web 2.0," highlighting user-driven, interactive web platforms. His work in publishing, thought leadership, and advocacy for open innovation has made him a central architect of today's digital and open knowledge ecosystem.

Salman Amin Khan widely known as Sal Khan, is the founder of Khan Academy, a non-profit educational platform that revolutionised global learning by making high-quality education freely accessible to all. Born in 1976 in Louisiana to parents of Bangladeshi and Indian origin, Khan holds degrees in Mathematics and Computer Science from MIT and an MBA from Harvard. His initiative began in 2004 when he started tutoring relatives online and posting instructional videos on YouTube, which gained widespread popularity. This success led to the founding of Khan Academy in 2008, which offers thousands of video lessons and interactive exercises across diverse subjects, with an emphasis on personalised, self-paced learning. Available in multiple languages, including Hindi and Malayalam, the platform empowers both students and teachers through data-driven tools and gamified learning experiences. Supported by organisations such as the Bill & Melinda Gates Foundation and Google, Khan Academy stands as a pioneering model of democratizing education through technology.

Z-Library: The Shadow Library

Z-Library is one of the largest online repositories of electronic books and academic papers. Known as a shadow library, it provides free access to copyrighted books and articles. Millions of people worldwide, particularly students and researchers from economically disadvantaged regions, rely on Z-Library for access to educational materials. Z-Library's central mission is to make knowledge accessible to all. By offering free access to academic books and research papers that would otherwise be prohibitively expensive, it helps democratize knowledge and provides valuable assistance to scholars and readers worldwide. It is especially beneficial to people living in areas with limited library infrastructure. The collection spans a wide range of subjects, including science, literature, art, and history.

However, Z-Library has been at the centre of major controversies, primarily due to copyright violations. Books are uploaded without the authors' or publishers' permission, which critics argue undermines both the publishing industry and the livelihoods of authors who depend on book sales. Many authors and publishers have spoken out against

the platform, citing significant financial losses. Law enforcement agencies in the United States and other countries have periodically seized Z-Library's websites, resulting in frequent disruptions to its operations. The closure of official sites has led to the rise of numerous imitation and fraudulent websites, further complicating the situation. In short, while Z-Library's mission to expand access to knowledge is laudable, its violation of copyright laws has drawn it into serious ethical and legal controversies.

LibGen: Another Shadow Library

Library Genesis (LibGen) is another major shadow library, like Z-Library. It provides millions of digital documents, including academic articles, scientific research papers, and books, all of which are freely downloadable. Its defining feature is that even copyrighted publications can be downloaded without cost. LibGen's significance lies in its commitment to making knowledge accessible. For students and researchers who cannot afford the high prices of academic journals and books, LibGen serves as a crucial resource. It is particularly beneficial for scholars in developing countries and institutions with limited library facilities, helping to spread knowledge more widely in society.

However, LibGen's operations are surrounded by serious controversies and legal challenges. Because it distributes books without the consent of authors and publishers, it violates copyright law. Critics argue that LibGen causes substantial financial losses to the publishing industry and to authors who earn their livelihood through writing. Consequently, many countries have imposed legal restrictions or bans on LibGen's websites. Despite repeated shutdowns, LibGen continues to reappear under new domains and mirror sites, maintaining its presence as an underground digital library. While controversial, its persistence underscores the ongoing tension between the universal right to knowledge and the protection of intellectual property rights.

Alexandra Elbakyan and Sci-Hub

Alexandra Elbakyan, a computer programer and neuroscientist from Kazakhstan, is globally known as the founder of Sci-Hub, the website that revolutionised free access to academic research papers. Elbakyan launched Sci-Hub in 2011 to help students and researchers who could not afford the high subscription fees required to read scientific journal

articles. By bypassing paywalls, Sci-Hub made millions of copyrighted academic papers freely accessible to users worldwide. Elbakyan firmly believes in the principles of Open Access, arguing that knowledge should be freely available to everyone. She maintains that research funded by public money should have its results openly accessible to the public. According to her, expensive subscription-based journals act as barriers to the free flow of knowledge.

Elbakyan's work and Sci-Hub have faced significant legal challenges from publishers worldwide. Multiple lawsuits, particularly in the United States, have accused Sci-Hub of copyright infringement, leading to bans and domain seizures. Despite these actions, Elbakyan remains admired by many for democratizing access to scientific knowledge. By providing free access to research for scholars and individuals in countries unable to afford the cost of costly journals, Elbakyan has earned the nickname "The Robin Hood of Science." However, her actions remain controversial, as critics argue that violating copyright laws undermines the legal and ethical foundations of academic publishing.

CHAPTER EIGHT

Wikipedia: The Free Collaborative Encyclopaedia

Wikipedia is a landmark in the history of digital collaboration and open knowledge. Built on the ideals of the Free Software and Open Knowledge movements, it embodies the principle that information should be freely available to everyone. Wikipedia is a collaborative encyclopedia that began with the noble goal of making free information available to people of all walks of life, speaking various languages, worldwide. The content on Wikipedia is published under a free licence, allowing anyone to use the information at any time without restrictions. Wikipedia follows the fundamental principle of Cooperation and Sharing, where volunteers from all over the world gather and publish information. Wikipedia grants complete freedom not just for writing articles, but also for correcting published articles and adding new information.

The Birth of Wikipedia

American internet expert Rick Gates first conceptualised the idea of "The Internet Encyclopaedita" in 1993. As part of this endeavour, an effort was made to organise an internet encyclopaedia called Interpedia, but due to the technical limitations of the early World Wide Web, it did not progress significantly. Later, American technology experts Jimmy Wales and Larry Sanger jointly initiated Wikipedia.

In 1996, Jimmy Wales started a web portal called Bomis. This later developed into a website called Nupedia in 2000, where only experts were allowed to write articles. Larry Sanger was appointed editor-in-chief of Nupedia. The idea of Wikipedia was conceived as a supplementary platform to Nupedia, allowing ordinary people to contribute. With this vision, both launched Wikipedia on January 15, 2001. Soon after, through the participation of people worldwide, Wikipedia developed its own distinct identity and made a bigger advance than Nupedia. Today, Wikipedia stands as the world's largest free encyclopedia.

Origin of the Name "Wikipedia"

The name "Wikipedia" is a blend of the Hawaiian word "Wiki" and the English word "Encyclopaedia." The Hawaiian word 'Wiki' (pronounced: WICK-ee) means "very quickly" or "fast," perfectly capturing the speed of collaboration. The word was first used in a computer programing context by the famous American computer programer Howard G. Cunningham. He drew inspiration from the "Wiki Wiki Shuttle," a bus service that travelled very quickly between the terminals at the Honolulu International Airport. Although it is often mistakenly thought to be an abbreviation of "What I Know Is," this is incorrect. Cunningham developed the first wiki software platform, called WikiWikiWeb, in 1995.

Wikipedia's Technical Structure and Licensing

The philosophy behind Wikipedia aligns closely with that of the Free Software Movement. Both promote freedom to use, study, modify, and share. Wikipedia rejects proprietary control of information just as Free Software rejects closed-source restrictions. Its foundation on the Free and Open-Source software MediaWiki ensures transparency, collaboration, and community-driven innovation.

Wikipedia's operations are built on a strong, open, and unique technical and legal framework. In its initial phase, Wikipedia used the UseModWiki software. However, since 2002, Wikipedia has operated exclusively on MediaWiki, a free and Open-Source software platform specifically designed for the encyclopaedia. MediaWiki runs on the PHP (Personal Home Page Hypertext Preprocessor) programmeming language and the MariaDB/MySQL database system, forming a robust framework for rapid, decentralised content management.

Wikipedia's content is primarily made available under the Creative Commons Attribution-ShareAlike 4.0 International Licence (CC BY-SA 4.0), with the GNU Free Documentation Licence (GFDL) also applicable to some material. This licensing framework ensures the permanent free availability and usability of all content. The entire venture receives financial and technical support from the Wikimedia Foundation, a non-profit organisation dedicated to fostering open knowledge. Users can navigate from the main Wikipedia website to language-specific versions for various countries worldwide.

Wikipedia Community: Wikipedians, Administrators, Bureaucrats

Those who volunteer their services on Wikipedia are called Wikipedians. Their collective body is also referred to as the Wiki Community. The community of Wikipedians is a collective that operates with a clear understanding of what Wikipedia is and adheres to principles such as a passion for knowledge, a willingness to share knowledge, and mutual respect. The number of Wikipedians is calculated based on the number of users who register on Wikipedia. While approximately five crore people are registered globally, it is estimated that about three lakh Wikipedians are actively contributing. In the English Wikipedia, there are 107,590 active Wikipedians.

Wikipedians work by finding time amidst their own jobs. Anyone with a computer connected to the internet can become a Wikipedian. Wikipedians grant permission for everything they create and contribute to Wikipedia to be used freely by other Wikipedians or the readers of Wikipedia. Some write articles for Wikipedia, some correct errors, some add images, and some link articles together. Thus, Wikipedians perform a variety of tasks. Although disagreements sometimes arise among Wikipedians, they are typically resolved through discussion. One can get to know them on the pages dedicated to Wikipedians on Wikipedia. Another distinct feature of these pages is the use of User Boxes to express their personal interests.

Some individuals on Wikipedia have greater responsibilities. They are called Administrators (Admins). Their main job is to remove unnecessary content from Wikipedia. The Wiki Community elects them to prevent people who may try to distort Wikipedia, and to modify pages that cannot be edited by everyone. Administrators are the protectors of the Wiki Community and the purifiers of Wikipedia

information by correcting errors. They also perform the same duties as regular Wikipedians.

'Bureaucrats' have more powers than Administrators. They are also elected by other Wikipedians. In addition to correcting errors and protecting their own and others' contributions, Bureaucrats are responsible for appointing and removing Administrators elected by the Wikipedians and making fundamental changes to Wikipedia's core operational policies.

Wikipedia's Growth and Linguistic Diversity

As of 2025, Wikipedia is available in over 340 active languages and hosts around 63 million articles. The English Wikipedia remains the largest, with over 6.8 million articles, while millions of people use it daily. Across all languages, more than 250,000 editors contribute each month, and over 100 million registered users have participated since its inception. The Malayalam Wikipedia continues to thrive, boasting more than 87,000 articles. Sister projects such as Wikimedia Commons and Wikidata now host over 100 million freely licenced media files and over 110 million structured data items, respectively, powering Wikipedia and other global platforms. The English Wikipedia is presently the largest, with over 70 lakh (7 million) articles. Millions of people use the English Wikipedia daily, with over 4,000 people reading it every single second.

It is noteworthy that Wikipedia's operations are providing a renaissance for many languages and scripts worldwide. A large global community of volunteers continually improves Wikipedia. They make thousands of edits every hour. All these changes are preserved in Wikipedia's history. Unnecessary changes are quickly removed, and users who persistently cause problems are blocked from editing. The true strength of Wikipedia lies in the collective will of those who share a desire to share knowledge, a goal to build a high-quality encyclopaedia, mutual respect, and a passion for learning.

The Uniqueness and Limitations of Wikipedia

Wikipedia is not a printed encyclopaedia. Therefore, it has no book-form editions or limitations on the number of subjects it can cover. Since it is an online encyclopedia, information about any subject can be added. Nevertheless, Wikipedia does not publish everything just because information is available. Rather than emphasising 100%

correctness, Wikipedia prioritises information that is accepted and suitable for an encyclopedia.

It is noted that Wikipedia's free, simple structure has certain limitations. Sometimes, information that is disturbing or hurtful to some people may be found on Wikipedia. Because it is a free system anyone can edit, there is a limitation: the information in the articles cannot always be guaranteed to be entirely correct. Critics have also argued that, because information is edited by numerous people, Wikipedia cannot always ensure the quality of its content.

Factual Accuracy and Neutrality

In recent years, Wikipedia has gained recognition for its growing reliability and transparency. While open editing can invite misinformation, continuous peer review by volunteers maintains accuracy. Programmes like 'Reading Wikipedia in the Classroom', led by the Wikimedia Foundation, now train educators and students to evaluate and contribute to Wikipedia responsibly, enhancing media literacy in the digital age.

Nevertheless, Wikipedia strictly mandates that everything written must be supported by clear evidence. Newspapers and other authentic publications are used as sources (references) for articles on Wikipedia. While writing articles after scrutinising reliable documents might seem difficult initially, continuous activity on Wikipedia makes it easier.

Although evidence is compulsory for everything that is written, it is not mandatory to include the source for absolutely every detail. References are not required for commonly accepted facts or information that are rarely doubted. Newspapers are the primary source of information for most articles. That is, a Wikipedian intending to write an article on a subject will find related newspaper reports and articles.

Wikipedia articles do not have specific, individual authors. An article will have been worked on by many individuals, and their perspectives will vary. Therefore, Wikipedia articles naturally adopt an approach that is equally acceptable to everyone. This means that Wikipedia inherently ensures neutrality. It is through this collaborative community of many people that the credibility of each article is ensured. This implies that if something is written incorrectly, there will be people to correct it.

Many writers and most information sources are often biased toward facts. Therefore, when a large group of writers presents information using various sources and perspectives, the content naturally takes on a neutral tone and authenticity. Wikipedia itself describes this process of handling diverse viewpoints together as the "Balanced Point of View." If someone feels their perspective is missing from Wikipedia, they are free to add it themselves, provided they support their claims with credible sources. What seems good to one person may seem bad to another. Therefore, Wikipedia aims to present information as facts.

Featured Articles and Quality Control

Wikipedia features a select number of key articles (Featured Articles) on its main page. Because these are the first articles readers notice, special attention is paid to ensuring their quality. On Wikipedia, like the English version, the main page is updated daily with newly selected articles. Only articles with near-complete information and high accuracy are published as Featured Articles. Before an article is selected as a featured article, Wikipedians make appropriate edits to it.

Wikipedians take utmost care to complete the article by adding all relevant information and correcting all errors. To ensure the article's credibility, Wikipedians add references to necessary books and other sources. When required images are added, an excellent, information-rich article results. A large collective of Wikipedians collaborates to prepare articles on Wikipedia. Some possess deep subject knowledge, while others have superior language skills. Subject experts might make grammatical errors, which are then corrected by those with language proficiency. Thus, excellent articles are shaped through continuous revision and editing.

Disputes and Vandalism

There is sometimes a risk on Wikipedia that some people will impose their opinions as truth. International, border, and political party disputes often become subjects of controversy. When many users rewrite an article from their own perspective, it is common for one person's contribution to be deleted by another. When this occurs, Wikipedia's Administrators try to protect the article's neutrality. They are often responsible for protecting the article from an "Edit War."

Some individuals write malicious or destructive content on Wikipedia. This is called Vandalism. Since anyone can edit Wikipedia, some

individuals might completely delete good articles, add unnecessary jokes, or add inappropriate images. Such individuals are warned by other Wikipedians. If they persist, the Administrators will block them from editing.

It cannot be said that Wikipedia is free of problems. Sometimes, certain antisocial elements attempt to insert incorrect information or advertisements on pages for their own benefit. However, volunteers monitoring those pages remove such content quickly. Wikimedia conducted an experiment to determine how long it takes to resolve such issues on the English Wikipedia. They found that all malicious edits could be reverted in under five minutes. The English Wikipedia proves that this is only possible because a large collective of people works behind the scenes.

Wikiversity Beta

Beyond Wikipedia, the Wikimedia Foundation maintains a rich ecosystem of sister projects, including Wikidata (a structured data repository), Wikimedia Commons (a free media library), Wikisource (a digital library), Wikibooks (free textbooks), Wikivoyage (travel guides), and Wikinews. Together, they form an interconnected framework dedicated to freely sharing the sum of human knowledge. The Wikimedia 2030 Movement Strategy envisions Wikimedia as the essential infrastructure of free knowledge for the future.

Wikiversity is a major educational initiative of the Wikimedia Foundation. In line with Wikimedia's vision of freely sharing knowledge worldwide, Wikiversity aims to provide a free platform for learning and research. Wikiversity Beta is a global platform that coordinates various language-based Wikiversity projects. It controls the overall mission and scope of Wikiversity while maintaining linguistic diversity. It also serves as an "Incubator" for starting new language Wikiversity projects.

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Currently, languages such as English, German, Spanish, and French each have dedicated projects on Wikiversity. Individuals wishing to start a Wikiversity in a new language must first find ten active representatives willing to work in that language. Once the required number of members is met, a request can be submitted through Meta-Wiki to establish a new language domain. Until then, the project's main page can be started by adding it to the project's template page. One of the primary goals of Wikiversity Beta is to develop international guidelines (including those for original research) that apply equally to all language projects and ensure their quality.

Beyond Wikipedia, the Wikimedia Foundation maintains a rich ecosystem of sister projects, including Wikidata (a structured data repository), Wikimedia Commons (a free media library), Wikisource (a digital library), Wikibooks (free textbooks), Wikivoyage (travel guides), and Wikinews. Together, they form an interconnected framework dedicated to freely sharing the sum of human knowledge. The Wikimedia 2030 Movement Strategy envisions Wikimedia as the essential infrastructure of free knowledge for the future.

History of Wikipedia in Indian Languages

In India, Wikimedia communities have played a pioneering role in advancing regional language Wikipedias. The Malayalam Wikimedia community, along with groups such as CIS-A2K and Wikimedia India, has supported free content creation, localisation, and digital literacy initiatives. Initiatives such as the Wikipedia Education Programme Kerala and Wiki Loves Monuments India demonstrate how Wikipedia contributes to preserving language, culture, and knowledge equity across the nation.

The first Wikipedia was launched in English on January 15, 2001. The German-language Wikipedia was launched on March 16, 2001. Subsequently, Wikipedia was also started in languages such as French, Chinese, Dutch, Hebrew, Italian, and Russian. Even a year later, until the middle of 2002, there were no significant efforts to start a Wikipedia in any Indian language.

In June 2002, Wikipedia was launched in Punjabi, Assamese, and Oriya; however, these three languages are no longer very active. After these three languages, the next Indian language to launch on Wikipedia was Malayalam on December 21, 2002. Following Malayalam, Wikipedia was launched in several other Indian languages: Bihari

in February 2003, Marathi in May, Kannada in June, Hindi in July, Tamil in September, Telugu and Gujarati in December, and Bengali in January 2004.

Wikipedia Day

Today, Wikipedia stands not just as an encyclopedia but as a living demonstration of collaborative human intelligence. It exemplifies how collective effort can sustain free knowledge without the constraints of commercial interests. By upholding transparency, neutrality, and accessibility, Wikipedia continues to inspire global movements for digital freedom and equitable access to knowledge. January 15, the day Wikipedia was founded, and the Creative Commons website was registered, is celebrated as Wikipedia Day. On this day, Wikipedia contributors discuss ways to further improve the encyclopedia. They review the achievements of the previous year and plan training programmes for individuals interested in contributing information to Wikipedia.

Wikipedia has redefined how the world produces and consumes knowledge. It has become a symbol of the Free Knowledge Movement, proving that when people share freely, humanity as a whole benefits. As part of the wider Wikimedia ecosystem, Wikipedia continues to grow, adapt, and reaffirm its mission: to make the sum of all human knowledge freely accessible to every person on Earth. Today, Wikipedia stands not just as an encyclopedia but as a living demonstration of collaborative human intelligence. It exemplifies how collective effort can sustain free knowledge without the constraints of commercial interests. By upholding transparency, neutrality, and accessibility, Wikipedia continues to inspire global movements for digital freedom and equitable access to knowledge.

NOTES

Howard G. Cunningham better known as Ward Cunningham, is one of the geniuses who silently revolutionised the world of computer science. This American computer programer first introduced the concept of Wiki to the world, an idea that fundamentally changed how information is shared. On March 25, 1995, he launched the first

wiki website called WikiWikiWeb. It was a platform that allowed users to easily edit web pages and add information—an idea that became the foundation of Wikipedia. Beyond the invention of the Wiki, Cunningham has made crucial contributions to software development methodology. He is a co-author of the Agile Software Development Manifesto. This approach for developing software quickly and efficiently has significantly influenced the modern software industry. He was also a frontrunner in developing concepts such as Extreme Programmeming (XP) and Design Patterns. Through his inventions, Ward Cunningham demonstrated how technology can be improved through collaborative effort and knowledge sharing.

Rick Gates is an American computer expert who played a vital role in the early growth of the internet. He gained prominence by advancing innovative ideas for sharing and collecting information. Gates was the one who proposed the concept of Interpedia, considered the precursor to Wikipedia. His proposal, made on October 22, 1993, on the Usenet News Group, suggested building a collaborative encyclopedia on the internet, which later inspired large ventures like Wiki. "The Internet Hunt," a monthly contest devised by Rick Gates as a practical way to find knowledge, is another of his major contributions. Launched on August 31, 1992, this contest challenged participants to answer ten questions using only internet resources. At the time, the contest was organised using tools like Usenet, Telnet, FTP, and Gopher. The contest ended in October 1994 as the World Wide Web became more widely prevalent. Rick Gates made significant contributions through his ideas to democratize access to knowledge, share information, and explore the potential of the internet.

Jimmy Wales (Jimmy Donal Wales) co-founder of Wikipedia and an American internet entrepreneur, was one of the main forces behind Wikipedia's vision. Ending his economic research at the University of Alabama, Jimmy Wales founded the web portal Bomis in 1996 and the online encyclopedia Nupedia in 2000. However, Nupedia's growth was slow due to strict academic vetting. The idea of Wiki emerged from recognising the need for a platform that could overcome this challenge and enable information to be shared quickly. The core vision and mission of Wikipedia—"to make the entire sum of all human knowledge freely available to every single person"—was Jimmy Wales's. He was keenly interested in maintaining Wikipedia as a non-profit venture. He played a crucial role in establishing the Wikimedia

Foundation, raising the necessary funding for Wikipedia's growth, and preserving its free and open nature. Wales's foresight and leadership were instrumental in transforming Wikipedia into one of the world's largest reference sources.

Larry Sanger (Lawrence Mark Sanger) the American co-founder of Wikipedia and a philosopher, played a key role in Wikipedia's early operations. While working as the Editor-in-Chief of Nupedia after completing his philosophy research at Ohio State University, the idea of starting a Wiki system to aid Nupedia's growth took shape in his mind. Larry Sanger and Jimmy Wales jointly launched Wikipedia on January 15, 2001. He was also the one who suggested the name "Wiki" for the platform. Sanger played a significant role in Wikipedia's initial organisation, policy formulation, and in guiding early editors and contributors. He served as Wikipedia's first "Editor-in-Chief." Though he was initially skeptical of the Wiki's collaborative nature, he supported Jimmy Wales's vision and worked to give Wikipedia a practical structure. Sanger later left Wikipedia and worked on several other online encyclopedias, including Citizendium. Although he has since raised concerns about Wikipedia's fundamental editing practices and reliability, Sanger's contributions to Wikipedia's birth and early growth were crucial.

CHAPTER NINE

Open Science: The Democratisation of Scientific Knowledge

The Free Software movement's ethos of 'Freedom, Co-operation, and Sharing' has shaped science, leading to 'Open Science.' This redefines knowledge creation, sharing, and use. Open Science insists on transparency, participation, and accessibility throughout research, ensuring progress benefits all.

Traditionally, patents, commercial interests, and monopolies-controlled research findings, but Open Science holds that scientific knowledge should be freely available for collective progress. It aims to make all research stages transparent and accessible. The UNESCO Recommendation on Open Science (2021) defines it as a global good grounded in four principles: Open Knowledge, Infrastructure, Societal Engagement, and Dialogue with Other Knowledge Systems, supporting inclusivity and equity in knowledge access.

Key Components of Open Science

Open Access allows anyone to read, download, and use scientific publications for free. Open Science supports access to knowledge across fields such as Physics, Chemistry, Social Sciences, and Humanities without financial barriers. The key components of Open Science are:

Open Data: Open Data means making raw research data and analysis methods publicly available. This facilitates the use of information from diverse fields such as climate studies, economic surveys, and astronomy. For example, open rainfall or temperature data enables varied research and new findings.

Open Methodology: Open methodology involves sharing the research methodology, computer code, and protocols in detail, ensuring the reproducibility of studies and facilitating error detection. This is essential, especially in computational science and data science. When a researcher's methods are clearly outlined, another person can repeat the same study and verify if the results are correct.

Open Peer Review: Open peer review makes the expert examination (peer review) that occurs before publication more transparent. The reviewers' opinions and information are made public, thereby increasing the credibility of the peer review process. This helps elevate the quality of the review and reduce bias in decision-making.

Open Educational Resources: Open Educational Resources (OER) freely share scientific knowledge, textbooks, and study materials, expanding educational access.

Open Biology: Open Biology accelerates the discovery of new medicines and makes a significant contribution to the development of 'Personalised Medicine' based on each individual's genetic structure. The rapid sharing of the virus's genetic structure and disease information during epidemics is crucial for finding vaccines and treatments. Open Biology strengthens this process. The COVID-19 pandemic dramatically underscored the power of Open Biology. The rapid sequencing and open sharing of the SARS-CoV-2 genome enabled global collaboration in vaccine and treatment development. Similarly, the Human Pangenome Project (2022) builds upon the Human Genome Project by mapping diverse genetic structures from global populations, reinforcing equity in genomic science.

Open Hardware: Open hardware makes the designs and construction methods for laboratory equipment, sensors, and microscopes available under open licences, paving the way for low-cost research in biology. This provides researchers in developing countries with opportunities to conduct modern studies. For example, open hardware lab equipment manufactured using 3D printing technology has revolutionised this field.

Collaborative Research: Collaborative Research uses platforms that let scientists worldwide share data in real-time, helping solve complex problems quickly. When scientists cross borders to interpret the same data, knowledge production is faster and of higher quality.

Modern Open Science relies on digital infrastructures like Zenodo, OpenAIRE, and EOSC to store and distribute research globally. In India, NDLI, INFLIBNET, and IOSN help keep data and findings accessible and sustainable. Open Science speeds up discovery by making information sharing easy. Researchers quickly build on others' work, increasing research reliability, reproducibility, and public participation, especially in developing countries.

Open Biology: Specific Applications and Challenges

Open Biology applies Open Science to fields like Genetics, Bioinformatics, Drug Research, and Medicine. It focuses on making large datasets, such as genetic, protein, clinical trial, and disease data, publicly available. This helps study diseases and discover new treatments. Platforms like PLOS collect and provide Open Biological Data.

The Human Genome Project (HGP), launched in 1990, aimed to map the entire human genome. Its core principle was public, free, and immediate access to all findings, without patents or privatisation. NIH Director Bernardine Healy wanted NIH to patent genes to prevent private monopolies and protect public investment. However, Human Genome Project Director James Watson argued that patenting public research would inhibit knowledge sharing. He insisted that genes be universal public resources. Disputes over patents and other issues led to Watson's resignation.

While the Human Genome Project progressed, Celera Genomics, led by Craig Venter, privately sequenced the human genome, aiming for patents and profit. This caused ethical and political controversy. Because the public project released information rapidly, much of the genetic data remained public and accessible, forcing Celera to partially abandon its patent efforts.

The SNP Consortium: An Open Science Model

Single Nucleotide Polymorphisms (SNP: pronounced "Snip") are the most common variations in the human Genome. This refers to differences that occur in a single Nucleotide within a person's DNA Sequence. For example, an SNP is when some individuals have 'Guanine' instead of the usual 'Adenine' nucleotide at a particular position.

SNPs can affect health, disease risk, and medication response. Such data predicts diseases, informs personalised drug choices, and reveals genetic links and disease mechanisms. If critical SNP data were monopolised by companies, research would slow, treatments would cost more, and public access would suffer. The SNP Consortium, a nonprofit of major institutions, was formed in 1999 to map 300,000 SNPs and make the information openly accessible, removing Intellectual Property restrictions.

The SNP Consortium operated during a period when attempts to patent genes and genetic data were active. Specifically, when private companies, such as Craig Venter's Celera Genomics, attempted to commercialise genetic information by privatising it, the SNP Consortium helped maintain this critical information in the public domain. This allowed researchers to utilise genetic data without incurring any costs or licensing issues. The availability of SNP data has led to significant advancements in areas such as disease research, drug discovery, and personalised medicine.

The SNP Consortium serves as a prime example of the Open Science principles, emphasising the importance of making scientific data publicly available. The work of the SNP Consortium, combined with the Human Genome Project, played a decisive role in maintaining human genetic information as a public resource. By prioritising the common good over private interests, the SNP Consortium accelerated scientific progress.

Open-Source Research Tools

Open Science initiatives have been extremely beneficial to researchers in India and other developing countries. Free publication platforms, Open-Source statistical tools, and simulation software reduce the cost of studies and research. Tools such as Python, R, JASP, Scilab, Octave, and Zotero facilitate the free and unrestricted performance

of scientific research. India's Department of Science and Technology (DST) is advancing a National Open Science Policy to ensure open access to all publicly funded research. Initiatives such as ShodhGanga, NDLI, and INFLIBNET repositories, alongside the Open Data Policy for Science and Technology, are major steps toward building an inclusive scientific ecosystem.

Python is a very popular, Open-Source programmeming language widely used in research across various scientific disciplines. Python is excellent for data analysis, machine learning, scientific simulations, and web development. Due to its extensive library collection, Python can handle complex calculations, visualise data, and develop computational models with ease. In the Open Science field, platforms like Jupyter Notebooks, which help share and re-examine research findings, run on Python. This is a simple yet powerful tool beneficial to scientists and students alike.

R is an Open-Source software widely used for statistical analysis and data science. R is equipped with facilities for large-scale computations, graphing, and model testing. It can be used in academic studies and research articles, and is available to anyone under its open licence. Many universities and research institutions in India today promote R.

JASP is an Open-Source statistical tool that is more user-friendly than R and can display graphs in real time. It includes many readily available statistical models, making it particularly suitable for social science researchers. Due to its user-friendly interface, it can be easily used by students and novice researchers.

Scilab is an Open-Source package used for mathematical simulation, control system design, and signal processing. Scilab is an excellent alternative to the large, expensive software MATLAB. Scilab is being utilised in the technical education sector and polytechnic educational institutions.

GNU Octave is also a free alternative to MATLAB. It can be used to analyse mathematical possibilities and model in fields ranging from Single-variable Calculus to Quantum Mechanics. Since programmes written in Octave run in MATLAB, exchanging content between the two platforms is easy.

Zotero is an Open-Source reference management tool used to collect references from various sources, such as research papers, books, and websites, and to incorporate them into articles in accordance with

academic styles. This type of tool is essential for academic writing and for M.Phil. and PhD research.

Jupyter Notebooks is an Open-Source platform for running programmeming languages like Python for Computation, Data Analysis, and Machine Learning. Jupyter Notebooks facilitate the presentation of academic studies and research in a clear and concise manner. It has several features that allow scientific studies to be shared online and grant others permission to re-examine or reproduce the findings.

OpenRefine is a very useful Open-Source tool for cleaning (Data Cleaning) large datasets, identifying their components, and reorganising them. OpenRefine helps easily cleanse and prepare survey data from social sciences, scientific documents, and health information for analysis.

Quantum GIS (QGIS) is an Open-Source Geographic Information System (GIS) used to collect, store, analyse, and visualise map-related information. QGIS is an excellent tool for Data Analytics in areas such as environmental studies, urban planning, and Water Resources.

Citizen Science: Growing Science Through Public Participation

'Citizen Science' refers to the active participation of the public in scientific research. Citizen Science involves collaboration between scientists and the public. Here, individuals without a formal scientific background seek answers to scientific questions by collecting information, analysing data, and solving problems. The main objective of Citizen Science is to bring science closer to society and provide the public with direct experience in scientific processes. The rise of mobile technology and Open-Source digital platforms has revolutionised Citizen Science. Initiatives such as eBird (Cornell Lab), Zooniverse, and COVID Symptom Tracker Apps allow millions to contribute real-time data for biodiversity, health, and climate studies. In India, efforts by the Kerala State Biodiversity Board and KDISC have enabled community-driven environmental monitoring and education.

Citizen Science offers several opportunities for the scientific community. Citizen Science methods help researchers collect data across vast geographical areas or over very long periods. For example, large-scale data collection is required for tasks such as monitoring migratory bird populations, observing climate change, and measuring

pollution levels. Such extensive operations, which scientists cannot undertake alone, are made possible through public participation in Citizen Science. This helps reduce research costs and simultaneously increases the speed of scientific discoveries.

Public participation enhances scientific literacy and fosters interest in science and technology among the new generation. By contributing directly, the public can gain a deeper understanding of scientific processes, cultivate critical thinking, and develop a sense of community involvement. This helps prevent science from becoming the monopoly of a select group of people and transforms it into common public knowledge. Local knowledge often provides very important information for scientific studies. Citizen Science helps local communities identify problems in their surroundings and find solutions through scientific methods.

Citizen Science Projects Successfully Implemented in Various Fields

Bird Watching: Through bird-watching programmes worldwide, volunteers collect data on bird populations, migratory routes, and habitat changes. Such information is essential for environmental studies and conservation efforts.

Climate Observation: Data collected and shared by the public, including rainfall amounts, temperatures, and pollution levels, aid in developing climate models and understanding environmental changes.

Astronomy: In projects like 'Galaxy Zoo,' the public analyses satellite images to classify galaxies and help scientists discover new phenomena.

Health Research: In some projects, people share their health information or help solve biological problems through games like Protein Folding (Foldit).

Environmental Monitoring: By collecting and sharing information on water quality, tree growth, and pest spread, environmental problems can be identified quickly and effectively.

Although Citizen Science has great potential, some challenges persist. It is important to ensure the accuracy and quality of the data collected by volunteers. Clear training and supervision are necessary to avoid biases in data collection and errors in recording information. Ensuring that participation is meaningful and adhering to data privacy and

ethics are also essential. If these challenges are overcome, Citizen Science will become a powerful force contributing significantly to knowledge accumulation and problem-solving.

When knowledge is shared openly, especially sensitive information such as individual health data, ethical considerations become even more important. It is essential to develop frameworks for responsible sharing that ensure privacy and data security. Citizen Science faces several other challenges, including overcoming the proprietary attitude among scientists, finding funding for Open Science, ensuring data standardisation, and reconciling Intellectual Property laws with open approaches. Ethical frameworks, such as the European Union's GDPR and UNESCO's Open Science guidelines, stress the need to balance openness with privacy and human dignity. Responsible Open Science demands safeguards for data protection, informed consent, and respect for indigenous and community-based knowledge systems.

Open Science, a grand endeavour to extend the ideals of 'growth through sharing' beyond technology, represents the democratisation of scientific knowledge. It dismantles monopolies, fosters global collaboration, and integrates research into the public sphere. In the age of Artificial Intelligence and data monopolies, Open Science remains vital to preserving intellectual freedom and the integrity of inquiry.

Open Science embodies the ethical and intellectual spirit of the Free Software Movement. It transforms research from a privileged endeavour into a collective, transparent, and participatory process. As nations and institutions adopt Open Science frameworks and infrastructures, humanity moves closer to realising a vision where knowledge serves not private profit but the collective advancement of civilisation.

NOTES

The Human Genome Project: An Open Science Success Story

The Human Genome Project (HGP) was an international scientific project that achieved a prominent place in the history of science, launched with the aim of fully understanding the human genome

and determining the location and function of each gene. The Human Genome Project is considered one of the largest scientific missions of the twentieth century.

Officially launched in 1990, the primary findings of this vast project were completed in 2000, and the complete Genome Mapping was finished in 2003. In 2022, scientists announced the completion of "Telomere-to-Telomere" (T2T) genome sequencing, which has enabled a deeper understanding of previously unmapped parts of the human genome, including telomeres and centromeres.

James Dewey Watson was the first Director of the Human Genome Project. He strongly argued that genetic information should be a public resource, available to everyone without restrictions. He resigned following disagreements with Bernardine Healy, the Director of the National Institutes of Health (NIH), over gene patents. Francis Collins, who succeeded James Watson as Director of the Human Genome Project, played a crucial role in advancing the genome project successfully.

Britain also contributed to the Human Genome Project. The Wellcome Trust and the Sanger Centre provided significant financial and technical support to the project. The British portion of the genome sequencing was led by the renowned biologist John Sulston. Like Watson and Collins, Sulston stood firm on the stance that genome information should be made immediately available to the public without any restrictions. Sulston and the Sanger Centre's role was extremely important in the competition with the private company Celera Genomics and in maintaining the information in the public domain.

One of the unique features of the Human Genome Project was that it initiated a special research programme, ELSI (Ethical, Legal, and Social Implications), at its outset. The goal of the ELSI project was to study the ethical, legal, and social implications of genetic research and raise public awareness about them. ELSI made significant contributions to issues such as the privacy of genetic information, genetic discrimination, and the misuse of genetic testing.

The Human Genome Project stands as one of the greatest examples of Open Science principles. This project was committed to making the discovered genetic information immediately available in public databases without restrictions. The Human Genome Project paved

the way for scientists worldwide to conduct research freely using this information, to arrive at new findings, and to bring about revolutionary changes in the pharmaceutical sector and in disease diagnosis. The role of the Human Genome Project in transforming genetic information into a public resource for humanity rather than a monopoly held by an individual or institution is unparalleled.

James Watson (James Dewey Watson) is a famous American molecular biologist and geneticist. He became world-renowned in 1953 through the discovery of the Double Helix Structure of DNA along with Francis Crick, Maurice Wilkins, and Rosalind Franklin. Watson shared the Nobel Prize in Physiology or Medicine in 1962 with Francis Crick and Maurice Wilkins for their discovery of the structure of DNA. Watson, who was the first Director of the international Human Genome Project, is the author of several famous books, including The Double Helix (1968) and DNA: The Secret of Life (2003). Born in 1928, Watson is now 97 years old.

Craig Venter (John Craig Venter) an American geneticist and entrepreneur played a pivotal role in sequencing the human genome through his private enterprise. While working at the National Institutes of Health (NIH), he gained fame for developing the technology known as Expressed Sequence Tags (ESTs), which significantly accelerated gene identification. He left the NIH in 1992 and founded the nonprofit Institute for Genomic Research (TIGR). In 1998, he founded the private company Celera Genomics to rapidly sequence the human genome. Competing with the Human Genome Project, he announced the completion of the preliminary human genome sequence in 2000 using his own method, 'Shotgun Sequencing,' which spurred the Human Genome Project to accelerate its research. His contributions to the creation of Synthetic Genomes and in the field of Synthetic Biology are notable.

Francis Collins an American physician and geneticist, has made significant contributions to research that identifies disease-causing genes. He discovered the genes responsible for many genetic diseases, such as Cystic Fibrosis and Huntington's Disease. Taking charge as the Director of the National Human Genome Research Institute in 1993 after James Watson, Collins played a critical role in completing the Human Genome Project. His commitment to making genetic information publicly available was a significant asset to the scientific community, even amid competition with Celera Genomics. He also

served as the NIH Director from 2009 to 2021. He has authored several books on the relationship between science and faith. Prominent among these are The Language of God: A Scientist Presents Evidence for Belief (2006), The Language of Life: DNA and the Revolution in Personalised Medicine (2009), and Belief: Finding Faith in an Age of Science (2011).

John Sulston (John Edward Sulston) a British biologist, is renowned for his groundbreaking contributions to genomics and his steadfast commitment to the free sharing of scientific information. He was awarded the Nobel Prize in Medicine in 2002, along with Sydney Brenner and Robert Horvitz, for his studies on cell division and the genome of the worm Caenorhabditis elegans. Sulston played a major role in leading the British component of the Human Genome Project. As the founding Director of the Sanger Centre, Sulston played a critical role in sequencing approximately one-third of the human genome. He took a strong stance against patenting scientific information. Sulston argued that making human genetic information fully public would accelerate research and spur scientific advances. John Sulston will always be remembered as a strong advocate of Open Science. Sulston passed away in 2018 at the age of seventy-five.

CHAPTER TEN

Open-Source Drug Discovery: A Collaborative Movement in Pharmaceutical Research

Global efforts are challenging the crises caused by the patent system in pharmaceutical research. The Open-Source Drug Discovery (OSDD) initiative stands out as a decisive model, aiming to transform drug research by applying the Free Software principles of freedom, collaboration, and sharing. OSDD directly opposes monopolistic barriers by promoting open access and collective action.

Like free software, OSDD ensures pharmaceutical knowledge is open to all, rejecting private ownership of research. The initiative centres its mission on accessible, affordable medicines by treating drug innovation as a public good. OSDD addresses the patent system's privatisation of knowledge head-on, advocating open knowledge to counter the imbalance in healthcare access.

The pharmaceutical sector is dominated by multinational drug companies. The drugs and vaccines they develop are protected by patents. For 20 years, these companies have had exclusive marketing rights. They can set drug prices and market them in chosen countries whenever they want.

Under India's Patents Act of 1972, we could manufacture low-cost generic drugs by using an alternative Process Patent method. However,

after the 2005 law change to comply with TRIPS, the Product Patent system began. This ended the right to make affordable generics, leading to soaring drug prices. Medical equipment and biotechnology are increasingly patented, limiting their accessibility, especially in developing countries. For example, while PCR technology, developed by Kary Banks Mullis and colleagues, was initially patented by Cetus Corporation, its wider availability at a lower cost became possible only after the patent expired.

Many companies patent the genetic structure of pathogens, restricting access to information needed for life-saving drug and vaccine development. Patent holders often demand high royalties on genetic information, thereby monopolising production and inflating prices.

In health, patents increase drug prices and create other serious problems. Since patent-driven monopolies focus on profit, major drug companies often ignore diseases affecting poor countries and disadvantaged groups. This results in neglected diseases lacking effective treatment.

Patents create a marketing monopoly that allows drug companies to inflate medicine prices, excluding vulnerable populations from life-saving treatments and straining public health budgets. This monopoly drives significant social and economic harm. OSDD and similar movements emerge as powerful responses, actively working to break this cycle and challenge the injustices rooted in patent-driven exclusivity.

Open-Source Drug Discovery

Open-Source Drug Discovery (OSDD) initiatives, following Copyleft and Creative Commons models, have launched in several countries. OSDD relies on cooperation, social participation, and transparency, letting anyone interested contribute to drug research.

OSDD research brings together scientists and institutions across nations, primarily to identify medicines for neglected diseases that do not attract commercial interest, with the aim of affordable public access. While private companies conduct closed research, OSDD champions open, transparent, and accessible research.

Recently, Artificial Intelligence, Machine Learning, and Big Data have become key to OSDD. Open repositories host millions of compound libraries and genome datasets, analysed collaboratively through AI-

driven open platforms like DeepChem, Open Molecule Generator, and partially open-access AlphaFold. These tools greatly reduce the time and cost of early-stage drug discovery, especially when used alongside Open Data and Open Science principles.

The Contributions of Medicines for Malaria Venture

Medicines for Malaria Venture (MMV) highlights how Free Software principles are redefining pharmaceutical research for malaria, a neglected disease. Large companies overlook malaria research due to low profits, making MMV's open approach crucial.

MMV, a non-profit public-private partnership founded in Switzerland in 1999, aims to reduce malaria through developing and ensuring access to necessary medicines. It works with a broad global network dedicated to malaria control and drug development. Their main goal is to develop new malaria drugs by sharing scientific knowledge and discoveries rather than focusing on market interests or patents. MMV collaborates globally with universities, research institutions, small biotech companies, and socially responsible pharmaceutical ventures, much as the Free Software community does.

MMV publicly shares data on malaria parasites, chemical compounds, and drug discoveries, enabling global scientific collaboration. This openness accelerates research and reduces duplication. MMV values multilateral cooperation over individual labs or companies. Experts from diverse institutions work together at each development stage. This approach optimises resources and promotes problem-solving from various perspectives. MMV releases findings through Open Access channels, spreading knowledge quickly for further research and discovery.

MMV works to ensure affordable access to malaria medicines in affected regions. By often avoiding or limiting patent protection, they enable broader manufacturing and have advanced several new drugs into clinical trials. MMV's initiatives highlight the impact Open-Source principles have on the fight against neglected diseases. Open collaboration and shared knowledge, as seen with MMV, demonstrate that drug research can serve global health needs rather than just profits. This approach, foundational to OSDD, envisions a world where alleviating suffering takes precedence over exclusive ownership.

Open-source drug discovery marks a moral transition from profit-first research to prioritising collective benefit. However, enduring

issues—like equitable data access and global researcher inclusion—remain. Leading global frameworks call for true openness, where knowledge is not just shared but participation is equitable, reinforcing OSDD's core argument for inclusivity. Newer technologies, such as blockchain, are being used to ensure transparency in data, authorship, and contributions in OSDD. Decentralised Science (DeSci) platforms such as Molecule and VitaDAO test tokenised funding to back community-led biomedical research.

Open-Source Drug Discovery reclaims medicine as a common good. It transforms the laboratory from a closed corporate space into a public commons of knowledge. By merging the ethos of Free Software with the moral urgency of global health, it offers a humane alternative to the current pharmaceutical order—an approach in which innovation serves not markets but humanity.

The Undermined CSIR Project

In India, the OSDD project was also launched under the auspices of the Council of Scientific and Industrial Research (CSIR). The first project undertaken by CSIR in 2008 was the initiative to find a new and effective drug for tuberculosis (TB).

TB continues to be one of the major health problems in most developing countries. With TB bacteria developing Multi-Drug Resistance (MDR-TB) to currently used medicines, TB treatment faces a major crisis due to the lack of effective new drugs. No new drugs for TB have been discovered after 1980, and the drugs recently marketed by Japanese companies are prohibitively expensive. With the advent of AIDS, TB has reappeared even in developed countries like the US. TB occurring secondary to AIDS often does not respond to currently available medicines at all.

In India, about thirty-seven TB patients die every hour (approximately 3,23,200 people annually). At the same time, large corporations have no commercial interest in researching new tuberculosis drugs. It was in this situation that the CSIR initiated the OSDD project, a social cooperation venture aimed at developing a drug for TB. CSIR had announced that all individuals and institutions contributing to the OSDD initiative would receive both financial and non-financial recognition. Once the drug was discovered, CSIR would hold the patent. The plan was to licence the drug's production to multiple companies willing to produce affordable generic versions, thereby

avoiding market monopolisation. The licence would not be restricted to a single company. This was intended to prevent any one company from dominating the market. The CSIR's OSDD model has become a public example of ensuring drug accessibility for everyone, regardless of their income, by integrating collaborative knowledge production with the patent system.

Although OSDD could identify basic drug molecules through social collaboration, subsequent animal and human testing would still need to be carried out under the leadership of specific institutions using traditional methods. Efforts were already underway to overcome this limitation using digital technology. Through a new OSDD-assisted initiative called Cheminformatics, it was possible to understand the biological properties of chemical molecules. The hope was that this could be used to determine the drug's efficacy and side effects through in silico (computer simulation) methods, thereby enabling drug development without requiring human testing.

Dr. Zakir Thomas was the founding director of the CSIR's OSDD programme. Dr. U.C.A. Jaleel and Dr. Vinod Scaria were active members of the core research team. Teachers and students from Malabar Christian College in Kozhikode collaborated on the OSDD research programme. They even composed a musical piece celebrating this great initiative, which offered hope to poor TB patients.

Other institutions that contributed to the OSDD project included the Centre for Computational Biology and Bioinformatics under the University of Kerala, the Chemical Teachers Academy, the Department of Chemistry at Cochin University of Science and Technology (CUSAT), and the Institute for Intensive Research in Basic Sciences (IIRBS) at Mahatma Gandhi University. IIRBS was the first to successfully identify a chemical molecule required for drug formulation. Research students from colleges under the University of Kerala also developed a few drug molecules after training at the CSIR National Institute for Interdisciplinary Science and Technology (NIIST) in Thiruvananthapuram.

Despite the research project being successfully executed with the participation of thirty-four academic institutions across the country, including those in Kerala, and around 4,500 scientists and technical experts from both India and abroad, the Central Government halted funding without providing any specific reason from 2014 onwards. Consequently, this highly relevant research initiative has stalled.

During the Eleventh Five-Year Plan, â,[1]forty crores were allocated for the project. The Planning Commission had requested â,[1]four hundred crores for the 12th Plan period. The Central Government undermined this highly socially relevant OSDD project by halting financial support precisely when the research, under the auspices of the prestigious National Institute of Tuberculosis and Respiratory Diseases in Delhi, was advancing toward the second phase of drug testing.

Although the original CSIR-OSDD programme was discontinued in 2014, its influence endures through the Open-Source Pharma Foundation (OSPF), which continues to promote open models for drug development in India and abroad. The OSDD's data repositories and collaborative frameworks have been integrated into newer AI-assisted platforms, demonstrating the model's long-term value in democratising scientific research.

Global Shift Towards People-Centric Research Initiatives

Drug research initiatives following the OSDD model have already begun in various countries. Collaborative Drug Discovery (CDD), launched in California in 2004, is a project that provides online access to biological and chemical drug research information for private individuals and public research institutions.

Cambia, a non-profit volunteer organisation based in Australia, has initiated projects such as Patent Lens and the Initiative for Open Innovation (IOI) to make information on Intellectual Property Rights laws accessible to researchers and institutions interested in collaborative research.

TDR Targets is a project jointly launched by the WHO and UNICEF to collect fundamental genetic information needed to develop drugs for diseases prevalent in tropical countries. Genetic factors (Drug Targets) that could help find a cure for Chagas Disease, which is prevalent in African countries, have already been identified as part of this project.

The Structural Genomics Consortium (SGC), a joint initiative among universities such as Oxford (UK), Toronto (Canada), and the Karolinska Institute (Sweden), is a project to analyse the three-dimensional structure of proteins with biological and pharmacological significance and make them available through a public website. Efforts are underway within the project to isolate proteins responsible for diseases such as diabetes, cancer, and genetic disorders. The plan is to

determine the 3D structure of 2,000 molecules, and information on 430 molecules has already been collected.

The Drugs for Neglected Diseases initiative (DNDi), a non-profit, collaborative research organisation dedicated to providing medicines for the treatment and prevention of neglected diseases, was founded in Geneva in 2003 under the leadership of French public health expert Dr. Bernard Pecoul. Within a short period, DNDi developed thirteen medicines for six diseases, including Sleeping Sickness, Leishmaniasis, Chagas Disease, Filariasis, Mycetoma, and HIV/AIDS.

The Sabin Vaccine Institute is working to develop vaccines to prevent neglected diseases, including Schistosomiasis, Dengue fever, Marburg virus disease, Leishmaniasis, Ebola virus disease, and Hookworm disease. The Sabin Vaccine Institute is a non-profit organisation founded in Washington, D.C., USA, in memory of the polio vaccine researcher Albert Bruce Sabin.

Since 2020, several international consortia have advanced the Open-Source model. The Global Health Drug Discovery Institute (GHDDI) in China and the Open Targets Platform in the UK are pioneering open data–driven biomedical research. The Medicines Patent Pool (MPP), supported by the UN, has also expanded beyond HIV/AIDS to include therapeutics for hepatitis, cancer, and COVID-19, demonstrating that global access to life-saving medicines can coexist with scientific innovation.

Open-Source Malaria

Open-Source Malaria (OSM) is a global research initiative that follows Open-Source principles to discover new drugs for malaria. Unlike conventional drug discovery, all data and ideas in this project are freely shared. Anyone can participate at any level, and it does not seek patents. This initiative has been described as the "Linux for Malaria Research."

OSM operates on the view that global problems like malaria, which claim the lives of millions of people every year, require global solutions. The collaboration receives contributions from diverse experts, including chemists, biologists, informaticians, and administrators from Melbourne, Sydney, Geneva, Cambridge, and Madrid. Everyone can share and learn from their research findings through a transparent online platform.

Matthew H. Todd, a British chemist, Professor and Chair of Drug Discovery at the UCL School of Pharmacy (University College London), is the founder of Open-Source Malaria. A strong advocate for Open Science and Open Research, he promoted and implemented an Open-Source approach to aid the discovery of new drugs for neglected diseases, including malaria.

In 2011, he put forward the "Six Laws of Open Research," which are the foundational principles guiding Open Research projects like OSM:

1. All data and ideas are freely shared.
2. Anyone can participate as an equal partner at any level of the project.
3. No patents will be sought.
4. Suggestions are the best form of criticism.
5. Public discussion is more valuable than private email.
6. An Open Research project is bigger than any one lab's ownership.

Matthew Todd also gained international attention by involving high school students from Sydney Grammar School in the low-cost production of the HIV/AIDS drug Pyrimethamine (Daraprim).

The goal of OSM, under the leadership of Matthew Todd, is to eliminate secrecy in the pharmaceutical research sector, enabling more efficient, faster, and transparent research. In addition to malaria, he is also involved in projects such as Open-Source Tuberculosis (OSTB) and Open-Source Mycetoma (MycetOS).

The Open-Source Pharma Foundation

With the spread of COVID-19, ideas and projects based on the Open-Source philosophy have been gaining momentum. The Open-Source Pharma Foundation (OSPF), which includes scientists like Dr. U.C.A. Jaleel and Jayakumar Menon, is leading this movement. The foundation points out that health products necessary for COVID-19 control cannot be developed without delay and duplication under the market-based 'business-as-usual' model. Open-Source movements stand for transparent Open Science, information sharing, and collaboration. Research conducted collaboratively is more cost-effective and enables the setting of priorities for neglected health conditions. Instead of market interests, the sole driver for Open-Source movements is the protection of the health of the world's population. Funding for Open-

Source research is sourced from international agencies such as the WHO, universities, crowdfunding, and philanthropists.

While the world population welcomed the marketing of COVID-19 vaccines by several companies, problems arising from their patent protection quickly became apparent. Fifty per cent of the vaccines produced globally were acquired and monopolised by the 14 per cent of the world's population living in developed countries. In India, at least 900 million people needed to be vaccinated to achieve the necessary level of herd immunity and bring COVID-19 under control. Achieving this goal using only Indian vaccines was neither feasible nor easy, as resources to purchase the high-priced, patent-protected vaccines from foreign countries were scarce. Considering this reality, India, along with South Africa and supported by countries such as Kenya, Mozambique, Pakistan, and Bolivia, requested that the WTO waive patent laws for COVID-19 products, including vaccines, until the pandemic was controlled. Dr. Carlos Maria Correa, the renowned Intellectual Property expert and Director of the South Centre (formed to support cooperation among developing countries), pointed out that, under Article 73(b) of the WTO's TRIPS Agreement, all countries have the right to take any necessary action in the interest of national security.

Taking this situation into account, the OSPF has launched an initiative called OpenVax to develop a vaccine for COVID-19 and future pandemics. Currently used and researched vaccines aim to develop Acquired Immunity specific to diseases. In contrast, the OpenVax initiative aims to develop a Universal Vaccine that can be used for multiple diseases simultaneously by fostering Innate Immunity and repurposing currently available, off-patent vaccines. For this purpose, vaccines like BCG, Oral Polio, and MMR are being tested. The American biologist Robert Charles Gallo, who contributed to the discovery of the Human Immunodeficiency Virus (HIV) and is currently researching an AIDS vaccine, has offered the technical assistance of the Global Virus Network (GVN), which he heads, to the OpenVax initiative. Open-source COVID-19 efforts have focused on testing, monitoring, and drug research to support COVID-19 control. Open-Source communities in various countries successfully implemented projects to develop low-cost, technically proficient diagnostic testing methods. The Health Care Clinical Virology Laboratory at Stanford University in the US developed the probes and primers required for

PCR testing, adhering to Open-Source standards. The global shortage of PCR test kits was resolved once the Stanford kits became available.

Open-Source activists in several countries have developed software to monitor individuals who have come into contact with COVID-19 patients via mobile phones, without compromising their privacy. The foundation also conducted drug trials to determine which existing antiviral medications used for other diseases could be effective for treating COVID-19. Additionally, they undertook efforts to identify potential Ayurvedic medicines for COVID-19 treatment using Artificial Intelligence. Open-Source COVID-19 initiatives were also active during the pandemic, including mass mask production, COVID-19 data analysis, and health education.

The OSPF, based in Bangalore and New York, continues OSDD's legacy. Its projects include the OpenVax Universal Vaccine Initiative and AI-driven modelling of tuberculosis drugs. OSPF envisions a 'Linux for Drugs'—a decentralised, transparent, and equitable ecosystem for drug discovery that prioritises public health over profit.

The OSPF envisions a transformative 'Linux for Drugs' model, which seeks to establish a decentralized, transparent, and equitable ecosystem for pharmaceutical innovation. By treating drug research as a public good rather than a proprietary commodity, this initiative prioritizes global public health over corporate profit margins. This approach decentralizes the traditional research environment, moving away from closed corporate laboratories toward a global knowledge commons where scientists can collaborate openly. Through the use of open data and crowd-sourced solutions, the 'Linux for Drugs' model aims to ensure that life-saving medicines remain accessible and affordable for all, particularly for the neglected diseases that current market-driven systems often ignore.

The legacy of the OSDD project continues to evolve through the OSPF, which has successfully integrated the principles of software freedom into the era of Artificial Intelligence. By leveraging AI-driven platforms for Cheminformatics, the OSPF and its partners can analyse millions of chemical compounds and genome datasets through a collaborative, open framework. This synergy between Open Data and machine learning not only reduces the time and cost of drug discovery for neglected diseases but also ensures that the resulting medical knowledge remains a public good, shielded from the restrictive barriers of traditional patent systems

Corbevax Vaccine: The Patent-Free Vaccine

When the COVID-19 pandemic gripped the world, vaccine availability became a major challenge. It was in this situation that the Corbevax vaccine was developed with the goal of being an affordable, patent-free vaccine for everyone. The development of this vaccine was spearheaded by prominent scientists, Drs Dr. Peter Hotez and Dr. Maria Elena Bottazzi, of Baylor College of Medicine in Houston, United States.

The Corbevax vaccine initiative has fulfilled its initial promises. This vaccine was developed with global vaccine accessibility in mind. The goal was to develop a vaccine that could be easily produced and distributed at a low cost. The researchers behind it were not interested in intellectual property rights or financial gain. Corbevax has been licenced, patent-free, to the Indian company Biological E. Limited (BioE), which plans to produce up to 100 million doses per month. Corbevax has been administered to millions of adolescents in India and has also received approval for use as a booster dose for adults. Current evidence suggests that the Corbevax vaccine provides long-term immunity and is generally safe. Its ability to store and transport at 28 °C makes it suitable for resource-limited countries. Corbevax is one of the cheapest vaccines currently available. The developers collaborate with an extensive network of partners worldwide. African nations, such as Botswana, have approved Corbevax and plan for large-scale production. Dr. Peter Hotez and Dr. Maria Elena Bottazzi, who developed Corbevax, were also nominated for the Nobel Peace Prize. The effectiveness of Corbevax against the Omicron variant is currently being investigated. The Corbevax vaccine initiative is considered a model for addressing global vaccine inequality.

Corbevax not only represents an open, patent-free vaccine but also sets a precedent for public–private partnerships rooted in transparency and openness. Its model shows that by removing intellectual property barriers, lifesaving vaccines can be rapidly distributed in developing nations without dependence on monopolistic pharmaceutical structures.

The Open COVID Coalition

Just as software freedom depends on legal frameworks such as the GNU General Public Licence (GPL), the open drug discovery movement relies on transparent and adaptable licensing mechanisms.

Frameworks like the Open COVID Pledge, Medicines Patent Pool (MPP), and Creative Commons for Data exemplify how open licensing can accelerate innovation while preserving ethical use and credit. During the COVID era, some large corporations were willing to embrace the Open-Source philosophy. The Open COVID Coalition, formed by lawyers and researchers working on the international stage, launched several notable initiatives, including the Patent Pool. The Patent Pool is intended to publish the patents for health products and to grant a temporary licence to those who express interest in producing them after reviewing the patents. However, it has the limitation that the producing company would still have to pay a royalty to the patent-holding company. Nevertheless, the Patent Pool helped end the single-company production monopoly and reduced product prices to some extent.

The Open COVID Pledge is another initiative of the Open COVID Coalition. Companies such as Intel, Microsoft, Hewlett-Packard, Facebook, Amazon, and Uber have announced their participation in the pledge, stating they will temporarily waive their patent rights for COVID-19 control measures.

The Costa Rican government, in collaboration with the World Health Organisation, launched the COVID-19 Technology Access Pool (C-TAP) initiative in May 2020. C-TAP is envisioned as a mechanism to make the knowledge and information required for researching health products needed to combat COVID-19 publicly available, without delay, obstruction, or duplication.

Recent Indian Developments

India has recently undertaken several important initiatives that align closely with the philosophy of Open-Source Drug Discovery and Open Science. The National Research Foundation (NRF) Bill, 2023, marks a significant policy milestone, emphasising open-access publication and the sharing of publicly funded research. The Department of Biotechnology (DBT) has begun integrating Open Science principles into the life sciences, encouraging the use of open-access repositories, shared genomic databases, and collaborative biomedical networks. Meanwhile, the Make-in-India for Health (MedTech) programmes are exploring open innovation partnerships between public institutions, private industry, and start-ups, promoting indigenous development of affordable diagnostic and medical technologies. Together, these

efforts demonstrate India's growing commitment to democratizing science and fostering a culture of openness, self-reliance, and global collaboration in health innovation.

A New Culture of Knowledge Production

Challenging computer monopolies, the Free Software philosophy has fostered a novel culture of scientific knowledge production worldwide, grounded in knowledge sharing. That same vision is now gaining strength and growth in the global drug research sector. The efforts underway through Open-Source Drug Discovery initiatives and the Open-Source COVID Movement are not merely technological advancements; they are powerful socio-political movements aimed at securing the fundamental human right to health. Herein a great forward march is ignited to free knowledge and utilise it for the welfare of humanity.

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Dr. Bernard Pacoul is a prominent French doctor and public health expert. He is the Founding Director of the non-profit organisation Medicines for Malaria Venture (MMV), which aims to find drugs for neglected diseases. He was inspired to address the lack of available medicines for neglected diseases while working with the organisation Médecins Sans Frontières (MSF: Doctors Without Borders) in the 1980s. Dr. Pacol has played a major role in promoting Open-Source drug research models through Public-Private Partnerships.

Albert Bruce Sabin (1906-1993) was a medical scientist born in Poland who later became a U.S. citizen. He is globally renowned for developing the Oral Polio Vaccine (OPV). The vaccine he developed in the 1950s played a decisive role in eradicating polio worldwide. Due to his commitment to public health, he opposed obtaining a patent for his invention and helped ensure the polio vaccine was made available free of charge in poor countries around the world.

Matthew H. Todd is a prominent chemist in the field of Open-Source drug discovery. A Professor at University College London, he actively works to guide academic research toward drug discovery using Open-Source principles, thereby benefiting the public. He

practically demonstrated the potential of Open-Source collaboration in global drug research for neglected diseases. He has made significant contributions to promoting transparency and participation by openly sharing his research findings with the scientific community.

Dr. Peter Hotez is an American scientist, paediatrician, and vaccine researcher. He has made notable contributions to vaccine development for neglected tropical diseases and emerging diseases, including COVID-19. He is the Dean of the National School of Tropical Medicine at Baylor College of Medicine and Co-Director of the Texas Children's Hospital Centre for Vaccine Development. He is an outspoken advocate against vaccine misinformation and for the importance of openly sharing scientific information.

Dr. Maria Elena Bottazzi is a prominent vaccine scientist born in Honduras who later became a U.S. citizen. Along with Dr. Peter Hotez, she serves as the Co-Director of the Texas Children's Hospital Centre for Vaccine Development and the Associate Dean of the National School of Tropical Medicine at Baylor College of Medicine. She played a key role in the development of the Corbevax vaccine, which was made available at a low cost worldwide, especially in developing countries, to combat COVID-19. Dr. Bottazzi is a strong advocate for open vaccine development models, arguing that vaccines should be a global public good.

Dr. Carlos Maria Correa of Argentina is a prominent intellectual property expert, economist, and lawyer. He holds degrees in law and economics, as well as a doctorate in law, from the University of Buenos Aires. He served as the Director of the Centre for Interdisciplinary Studies on Industrial and Economic Law (CEIDIE). He has deep knowledge of trade, technology transfer, intellectual property, and public health in developing countries. He was a member of several international commissions and expert committees, including the WHO's Commission on Intellectual Property, Innovation and Public Health (CIPIH). He has advised governments in various countries on intellectual property laws and policies and has authored numerous books and articles. Currently, he serves as the Executive Director of the South Centre, an intergovernmental organisation that promotes the development interests of the Global South. Dr. Correa's contributions are crucial in viewing intellectual property, especially concerning access to medicines, through a development lens.

Robert Charles Gallo an American biomedical researcher, made pioneering contributions to virology and AIDS research but was overlooked for the Nobel Prize. His early work on T-lymphocyte cells led to the discovery of the first human retrovirus, the Human T-Cell Lymphotropic Virus (HTLV), for which he received the 1982 Lasker Award for Basic Medical Research. In 1984, Gallo and his team identified the HTLV-III virus in AIDS patients—later confirmed as HIV—establishing its role as the causative agent of AIDS and earning him a second Lasker Award in 1986, a distinction unique in the award's history. Despite his crucial role, the 2008 Nobel Prize for the discovery of HIV went instead to Luc Montagnier and colleagues at the Pasteur Institute. In 1996, Gallo founded the Institute of Human Virology at the University of Maryland, where he continues his groundbreaking research on AIDS and related viral diseases.

Zakir Thomas was the Founding Director of the Council of Scientific and Industrial Research's Open-Source Drug Discovery (CSIR-OSDD) Project in India. He holds an M.Sc. in Physics from Mahatma Gandhi University and a LL.B. degree from the University of Delhi. He also has a master's degree in Intellectual Property, Commerce, and Technology from the Franklin Pierce Law Centre at the University of New Hampshire in the United States. Dr. Zakir Thomas, who served as the Income Tax Commissioner in Delhi within the Indian Revenue Service, retired on May 31, 2024, as Director General of Income Tax (Systems) at the Central Board of Direct Taxes. He has previously served as the Registrar of Copyrights for the Government of India. He also headed the Technical Cell of the Director General of CSIR, which provided technical and policy assistance. He was a member of the panel formed to collaborate with the UNDP and the World Health Organisation (WHO) on policies related to access to medicines and biomedical innovation.

Dr. U.C.A. Jaleel is the Principal Scientist at the OSPF-NIAS Drug Discovery Lab on the NIAS, IISc campus in Bangalore. He leads a team of drug researchers focusing on various aspects of Cheminformatics, including Machine Learning (ML) and Artificial Intelligence (AI)-based analysis of neglected tropical diseases such as tuberculosis, malaria, and leishmaniasis. He successfully applied Artificial Neural Network (ANN)-based ML models to the molecules of tuberculosis bacteria. As the Principal Investigator of the Government of India's Open-Source Drug Discovery CSIR "Cheminformatics for Neglected

Diseases Project," he played a major role in building and managing crowdsourced and ML solutions to address various problems in tropical disease research. His main contributions include solutions to problems in high-dimensional analysis and the extraction of key features in the in-silico design of ML models. Dr. Jaleel is a strong advocate for Open-Source and supports crowd-sourced methods for drug research. Before joining OSPF in 2015, he worked for about twelve years at various institutions, including the Open-Source Drug Discovery research unit on the IISc campus in Bangalore (under CSIR) and the UGC Centre for Cheminformatics at Malabar Christian College, Kozhikode.

Jayakumar Menon is an international human rights lawyer, social entrepreneur, and the Founder of the Open-Source Pharma Foundation (OSPF). He serves as the Chair of OSPF, which is based in New York. He is also associated with Harvard and McGill universities. Menon holds degrees in law and international affairs from Columbia University, as well as a B.A. degree from Brown University. Menon, who has connections to Kerala, spent most of his career in the United States. He was the co-founder of the Double-Fortified Salt Project, which reached millions of people to address malnutrition and advance global public health initiatives. Through OSPF, he pioneered Open-Source models for developing affordable medicines. Notable among these are the 2-cent tuberculosis pill and the 20-cent innate immunity booster. Menon, who was featured on Newsweek's list of '50 Greatest Disruptors,' continues to lead movements for pharmaceutical accessibility and global health equity.

Dr. Vinod Scaria is a prominent biologist and medical researcher, recognised as a leading expert in Precision Medicine and Clinical Genomics. He gained fame for sequencing the first Indian genome. He also played a key role in sequencing the genomes of Sri Lanka and Malaysia. He contributed to the sequencing and analysis of the wild-type zebrafish genome and the IndiGen Programme, with a focus on genomics for public health in India. He currently serves as the Chief Data Officer at Karkinos Healthcare and as an Adjunct Professor at IIT Kanpur. Previously, he worked as a Senior Scientist at the CSIR-Institute of Genomics and Integrative Biology and as an Adjunct Faculty at the Indraprastha Institute of Information Technology, Delhi. A former MBBS student at Kozhikode Medical College, he began his professional career as a researcher at the CSIR-Institute of Genomics and Integrative Biology in New Delhi.

CHAPTER ELEVEN

Open-Source Hardware: Freedom in the Physical World

Just as the Free Software movement revolutionized computer programmes, 'Open-Source Hardware' extends these principles to the physical world. It gives everyone the freedom to access, study, improve, distribute, build, and sell designs, blueprints, firmware, and manufacturing methods for hardware products, including electronic devices and machinery. Open-source hardware is usually published under open licences, such as the CERN Open Hardware Licence (OHL) or Creative Commons licences.

Open-Source Hardware translates the ethical principles of Free Software into the material world. Just as users of Free Software have the right to study, modify, and redistribute code, users of Open-Source Hardware have similar freedoms over physical designs and manufacturing methods. This embodies the same commitment to transparency, decentralization, and collective creativity — but applied to tangible tools and technologies.

Unlike software licences, which govern digital code, Open Hardware licences must also address physical manufacturing, liability, and design integrity. The CERN Open Hardware Licence (OHL), launched in 2011 and updated in 2020, provides a comprehensive legal framework that allows anyone to study, modify, make, and distribute hardware

while ensuring that attribution and openness are maintained downstream.

Significance and Benefits of Open-Source Hardware

Open-source hardware enables significant advances across various sectors by accelerating technological growth. It fosters rapid development, error correction, and design improvement. It is especially valuable for reducing the manufacturing cost of scientific and medical equipment and expanding access to advanced technology for educational institutions and developing countries.

Open-source hardware designs are transparent, allowing anyone to inspect how they work. This promotes reliability, facilitates the replication of research, and enhances quality. Users can fully modify hardware to suit their needs. It creates excellent learning opportunities and helps users develop practical skills. Open-Source Hardware also helps counter Planned Obsolescence by extending product lifespans.

Applications for Open Hardware Across Various Sectors

- **Scientific Equipment:** Many tools used in research laboratories are expensive. Open-source lab equipment, including microscopes, sensors, and OpenPCR machines, facilitates cost-effective research.
- **3D Printers:** 3D printers based on Open-Source Hardware principles, such as the RepRap project and the Prusa i3, enable anyone to build and improve their own 3D printers.
- **Electronics Platforms:** Microcontroller boards, such as Arduino, feature Open-Source hardware designs. A microcontroller board is a small computer on a single integrated circuit used to control devices. Their Open-Source nature provides great encouragement to engineers and hobbyists to develop new projects.
- **Robotics:** Many Open-Source robot platforms accelerate robotics research and development.
- **Medical Devices:** During the COVID-19 pandemic, sharing designs for cost-effective, Open-Source ventilators and pulse oximeters played a crucial role in ensuring their availability.
- Open-source hardware principles encourage DIY projects by giving individuals access to information and tools that enable them to build independently. Maker Spaces support this, offering shared facilities and collective innovation. These spaces enable

collaborative building and knowledge exchange, rooted in the ideals of Open-Source Hardware.

Beyond the established domains of scientific instruments, electronics, robotics, and medical devices, Open-Source Hardware is rapidly advancing into several new and socially critical sectors. In renewable energy, Open-Source solar charge controllers, wind-turbine designs, and community-built microgrid systems are enabling affordable, decentralized power generation. In agriculture, projects such as Open-Source Ecology's Global Village Construction Set are creating modular, repairable machinery that supports sustainable farming and rural self-reliance.

The field is also witnessing growth in AI and edge-computing hardware, including open neural-accelerator boards and low-power processors that allow researchers and small enterprises to experiment without corporate restrictions. The success of Open-Source ventilators during the COVID-19 pandemic has, moreover, inspired a wave of Open-Source design efforts for oxygen concentrators, diagnostic kits, and biosensor platforms, proving that openness can save lives and resources. Together, these developments underscore that Open-Source Hardware is not confined to laboratories or hobbyist circles; it is becoming a practical pathway to technological equity, environmental sustainability, and collective resilience.

Intersection with Free Software and Challenges

Open-Source Hardware projects often depend on Free Software, such as firmware and design tools built on free applications. Both movements are grounded in principles of freedom, collaboration, and sharing.

However, Open-Source Hardware faces some unique challenges compared to Free Software. Manufacturing physical products requires raw materials, manufacturing equipment, and factories. This is more complex and expensive than software production. Other challenges include ensuring the quality of the manufactured hardware and the lack of legal clarity regarding liability for its use. Liability refers to the responsibility or legal obligation for damage caused by the use of a piece of hardware. Integrating Open-Source hardware designs into Intellectual Property (IP) systems, such as patent laws, poses a key legal challenge. Raising funds, increasing awareness about Open-Source Hardware, and gaining widespread acceptance are also

important. If these challenges are overcome, Open-Source Hardware has the potential to become a major force capable of radically changing the methods of producing and accessing technology.

Open-Source hardware has profound implications for sustainability and local economies. Enabling distributed manufacturing reduces dependence on global supply chains and encourages repairability and recycling. However, regulatory, safety, and liability frameworks must evolve to support this decentralized innovation model.

Maker Culture and Education

The Maker Movement, inspired by Open-Source ideals, integrates digital fabrication tools such as 3D printers, CNC machines, and laser cutters into educational settings. It promotes experiential learning, blending creativity and technology. In India, the Atal Tinkering Labs and FabLabs Kerala are notable examples that introduce open hardware culture to schools and communities.

While much of the Free Software philosophy has already been expressed in Open Hardware, a deeper layer of connection lies in their shared development ecosystem. Hardware design increasingly depends on open digital workflows—ranging from simulation environments to collaborative version control—many of which originated in the Free Software community.

The firmware–software continuum further strengthens this link: open devices rely on free firmware for control and interoperability, while open software frameworks enable seamless integration of sensors, networks, and embedded systems. The two movements thus represent a unified architecture of freedom, where code and circuitry co-evolve through openness, transparency, and collective participation. Free Software provides the cognitive infrastructure, and Open Hardware extends it into the material world—together, they embody a complete model of technological self-determination.

Growth and Future Potential of the Open-Source Hardware Movement

The Open-Source Hardware movement thrives through global collaboration, driving rapid innovation across fields such as Artificial Intelligence, Robotics, and Biomedical Devices. By making technology cost-effective, customizable, and transparent, Open-Source Hardware empowers wider access for all, especially in developing countries.

Overcoming its challenges can position Open-Source Hardware as a major driver of technology democratization worldwide.

Major global initiatives such as the Open Compute Project (OCP), RISC-V, and the Open-Source Hardware Association (OSHWA) have institutionalized openness in hardware. These efforts show how open collaboration can disrupt monopolies in fields such as semiconductor design, cloud infrastructure, and sustainable manufacturing.

India has also witnessed a growing Open Hardware movement, particularly in education and healthcare. Initiatives like IIT Bombay's e-Yantra project, FOSSASIA's hardware collaborations, and local 3D printing ventures in Kerala and Bengaluru embody the spirit of Open Hardware. The COVID-19 pandemic accelerated community-driven hardware innovation through open ventilator and sensor design projects. These global collaborations mirror similar movements emerging in India's educational and health innovation landscape.

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DIY Projects

'DIY' (Do It Yourself) projects refer to performing various necessary tasks in our daily life on our own, without the help of another person, using available information. DIY projects range from repairs and crafts to gardening, home decorations, and small electronic devices. DIY projects offer several benefits. In daily life, many tasks can be accomplished at a significantly lower cost than hiring experts. Every DIY project helps individuals learn new things and develop their own skills. The satisfaction gained from creating a product or solving a problem with one's own hands is immense. DIY allows us to customize products and decorations according to our taste. By reusing materials rather than discarding them and creating new products, waste is reduced, making it more environmentally friendly. The realization that one can do things independently boosts self-confidence. Numerous tasks, from small home repairs and creating decorative items from waste materials to setting up a home vegetable garden, can be accomplished through DIY projects. More than just a hobby, DIY is a lifestyle that enhances skills, reduces costs, and protects the environment.

CHAPTER TWELVE

OpenStreetMap: The Open Map of Knowledge

OpenStreetMap (OSM) is one of the most notable projects in the world of Free Software. It is a project created by volunteers who gather map data from across the globe to build a free, editable map of the world. OSM offers a powerful alternative to proprietary (closed and privately owned) mapping services like Google Maps. Just as Free Software (software whose source code is freely available for anyone to use, modify, and share) liberated code, OpenStreetMap has liberated geography, turning the Earth itself into a shared digital commons.

Unlike traditional map companies, OpenStreetMap has grown through community collaboration, modeled after Wikipedia. Users worldwide add detailed, accurate information to the map for areas they know well, using GPS data, aerial imagery, and local knowledge. Tools like Mapillary further improve OSM's accuracy and scope. Since 2004, OSM has become one of the most detailed and current map databases.

Features of OpenStreetMap

The core of OSM is its 'open' nature. The information is available under the Open Database Licence (ODbL), a licence for sharing databases.

This grants everyone the freedom to use, modify, redistribute, and even use this map data for commercial purposes, provided the attribution is maintained. ODbL differs from Creative Commons (a set of public copyright licences) licences as it specifically governs databases, ensuring that derivatives and redistributions remain open under the same terms, thereby preserving the commons.

Millions of volunteers form the backbone of OSM, achieving excellent local accuracy. OSM's independence from company control ensures vendor neutrality and allows users to create maps tailored to their needs.

Uses of OpenStreetMap

OpenStreetMap is widely used in navigation applications, disaster response, city planning, academic research, and by companies seeking to avoid commercial mapping fees. The Humanitarian OpenStreetMap Team is a notable example of its impact during emergencies. OSM increasingly leverages AI-assisted editing, drone imagery, and 3D mapping for better accuracy, with platforms like Mapillary, KartaView, and OpenDroneMap harnessing both community and machine intelligence.

Recent Applications and Integrations

Between 2020 and 2025, OpenStreetMap evolved from a crowdsourced mapping project into a critical layer of digital infrastructure. Open data now supports research, disaster response, environmental sustainability, and smart city planning worldwide.

In climate and environmental monitoring, OSM datasets (collections of map data) are integrated with remote-sensing (techniques to collect data about an area from a distance, such as by satellite) and satellite imagery (photos from space) to track deforestation, floods, and carbon emissions, in collaboration with organisations such as UNEP (United Nations Environment Programmeme), MapAction (a humanitarian mapping organisation), and Global Forest Watch (a monitoring initiative for forests). These partnerships demonstrate how open geospatial knowledge supports both mitigation (reducing impacts of disasters) and adaptation (adjusting to change) strategies.

In public health, OSM made significant contributions to COVID-19 response efforts, facilitating the mapping of health facilities, vaccination logistics (the organisation and transportation of

vaccines), and contact-tracing routes (paths used to identify who may have encountered infected individuals). Open geographic data have become an essential public health resource, enabling rapid visualization of pandemic trends at both local and global scales.

The rise of AI (artificial intelligence) and machine learning (computer systems that learn patterns in data) has further expanded OSM's reach. Tools like Facebook's MapWithAI, Google's AI-assisted mapping, and Microsoft's AI-derived building footprints use OSM data for automated feature extraction (identifying map elements automatically), validation (checking for correctness), and accuracy improvement. This convergence of community knowledge and artificial intelligence marks a new era of human-machine collaboration in mapping.

In transportation and urban planning, OSM supports open mobility ecosystems. It powers real-time navigation, public transit mapping, and smart city infrastructure. Projects like India's Gati Shakti and several European networks use OSM for integrated, transparent, and cost-effective infrastructure planning.

Together, these developments show that OpenStreetMap is now more than a volunteer project. It has become a foundational part of the world's open-data ecosystem, bringing technology, governance, and civic collaboration together for a more transparent, sustainable future.

Humanitarian OpenStreetMap Team

The Humanitarian OpenStreetMap Team (HOT) is a key subgroup of the OSM community. This international volunteer group urgently provides free, detailed map information to areas hit by disasters, health crises, and humanitarian emergencies. Their maps support relief operations before and after such events.

Using satellite images (pictures taken from space) of disaster-affected areas, volunteers from around the world use Remote Mapping (marking features on maps without being physically present) to mark roads, buildings, rivers, and other infrastructure, providing essential base map information for relief workers to coordinate their activities. If the information gathered through remote mapping is incomplete, local volunteers go directly to the field and use mobile apps and GPS devices to collect accurate data onsite (Field Mapping) and add it to the map. They also provide map-creation training to local communities, equipping them to face future disasters.

During disasters, outdated or inaccessible maps are a challenge. Through HOT's efforts, up-to-date, accurate map information is quickly made available to support rescue, relief, and rehabilitation. HOT has helped in many global disasters, such as the 2010 Haiti earthquake, the 2014 Ebola outbreak, the 2015 Nepal earthquake, and the 2018 Kerala floods, demonstrating how open data and collective action can transform disaster management.

Recently, HOT's work has grown beyond crisis response. They now focus on climate resilience, refugee settlement mapping, and sustainable development planning. With AI-assisted remote mapping and open data partnerships with UN agencies, HOT now plays a key role in anticipatory action. This enables communities to prepare for disasters before they happen.

Foundation, Ethics, and Inclusivity

The OpenStreetMap Foundation (OSMF) is a non-profit that supports OSM's growth. While OSM is global, its strength is in its local communities. Groups like 'GeoLadies' and 'WomenMap' encourage women to participate in mapping. They help attract women and bridge gender gaps in mapping. Local OSM chapters coordinate operations worldwide. For example, OpenStreetMap India organizes mapping events and trains new mappers. Through these chapters, the global OSM community meets the local needs of each country.

Open mapping presents new ethical challenges, including protecting sensitive data, safeguarding individual privacy, and preventing the misuse of geographic information in conflict zones. The OSMF now emphasizes community consent (agreement from people affected), data anonymization (removal of identifying details), and ethical mapping principles in its updated guidelines.

Mapping the Digital Commons: The Triumph of Open-Source Collaboration

OpenStreetMap fully follows Free and Open-Source Software principles. It ensures data freedom. Most tools for map creation, like editors and rendering software, are also free and Open-Source. OpenStreetMap is a prime cartographic expression of Free Software's vision to liberate knowledge. It stands as an inspiring model of how big projects succeed in the digital world through collaboration. OpenStreetMap demonstrates that knowledge—whether textual,

scientific, or geographic—reaches its full potential when shared. Like Wikipedia and Free Software, OSM redefines what it means to own, contribute to, and benefit from collective human intelligence.

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GeoLadies collectives are global initiatives aimed at reducing gender disparity within the OpenStreetMap community. They operate either as part of or in conjunction with local OpenStreetMap communities in each country. Groups like GeoLadies Philippines (GeoLadies PH), which became active in 2018, operate independently and in collaboration with larger organisations such as the Humanitarian OpenStreetMap Team and YouthMappers. They strive to increase women's participation in the technical sector and open mapping, and to create safe and encouraging spaces for them. GeoLadies takes the initiative to attract more women to this field by organizing mapping events, training sessions, and workshops. These collectives often receive support from the OpenStreetMap Foundation's operating groups, as well as from agencies such as the Wellcome Trust and local volunteer organisations.

WomenMap is a general term for initiatives that map the specific needs of women and ensure their representation in public knowledge. This is not a single specific organisation, but rather a concept. Organisations like the Humanitarian OpenStreetMap Team (HOT) have often led such mapping initiatives. For example, HOT Indonesia organized a mapping event under the name "#WomenMap" in conjunction with International Women's Day in 2017. Institutions like the Australian Government and UN Women often support WomenMap projects. WomenMap initiatives encourage the recording of information on women's safety, health, sanitation, and childcare on OpenStreetMap. By mapping safe routes, restrooms, women-friendly institutions, and health clinics, these mapping efforts play a significant role in enhancing women's daily lives and informing policy formulation.

The OpenStreetMap Foundation (OSMF), established in 2004, is a non-profit organisation that supports the OpenStreetMap project by providing legal, technical, and community support. Its main activities include server maintenance, licensing, and maintaining open and

accessible map data, all of which are made possible by volunteers and donations.

The OpenStreetMap India Community is one of the countries with active participation in OpenStreetMap's global network. The OpenStreetMap India Community contributes significantly to map creation and data collection in the country. Thousands of volunteers nationwide help make India's digital map more accurate and detailed by adding their local knowledge. The OpenStreetMap India Community regularly organizes mapping parties, workshops, and meetups. Such activities are vibrant in cities such as Delhi, Bengaluru, Kochi, and Thiruvananthapuram, as well as across various regions of Kerala. They play a significant role in disaster relief efforts, providing information to local self-governing bodies and preparing maps in local languages. The OpenStreetMap India Community also collaborates with the country's Free and Open-Source Software (FOSS) community. The primary objective of the collective is to enhance the availability and quality of maps in the Indian subcontinent.

The Government of India's 2021 Geospatial Data Liberalization Policy greatly expanded public access to mapping data, aligning national policy with OSM's principles. As a result, OSM India collaborates with local governments and civic organisations on disaster mapping, urban planning, and climate adaptation projects.

CHAPTER THIRTEEN

Free Software and Open-Source Movements

Free Software is more than code; it is a global movement based on strong values. The movement highlights 'freedom' over 'free of cost.' The Free Software philosophy lists four basic freedoms: to run, study, change, and share the software. Many groups, declarations, and announcements helped shape and spread these ideas and gave them legal and social acceptance.

The Free Software philosophy spread to other fields, enabling open sharing. It grew beyond technology and encouraged many 'open' movements, like Open Science, Open Data, Open Hardware, and Open-Source Drug Discovery. In recent years, ideas from Free and Open-Source Software have spread to new areas, such as artificial intelligence, cloud computing, and control over technology. More governments and research centres see Open-Source as key to trust and independence.

Alongside the broadening influence of Free and Open-Source Software, several global organisations are working to promote the Free Software philosophy worldwide and provide legal and technical support.

The Free Software Foundation

The Free Software Foundation (FSF) is a non-profit organisation started by Richard M. Stallman in Boston, USA. The FSF introduced the idea of Free Software and set out its four freedoms: to run, study, change, and share software. Its main aim is to spread software freedom worldwide. The FSF made the GNU Project well known. It also published Copyleft licences, such as the GNU General Public Licence, the GNU Lesser General Public Licence, the GNU Free Documentation Licence, and the GNU Affero General Public Licence. The FSF also fights against Digital Restrictions Management (DRM), a way for companies to control digital music, movies, and e-books. The FSF encouraged groups such as the Free Software Foundation Europe, India, and Latin America. Board members include Stallman, Gerald J. Sussman, John Gilmore, Geoffrey Knauth, and Christina Haralanova.

The Open-Source Initiative

The Open-Source Initiative (OSI) is an organisation in California that defines the term 'Open-Source' and approves licences that comply with Open-Source principles. Founders like Eric S. Raymond and Bruce Perens led the OSI. It focuses on practical and business uses of free software. The OSI lists approved licences, such as the Apache, MIT, and Mozilla Public Licences, as well as GPL versions. The OSI helps grow the Open-Source community and promotes non-proprietary software.

The Linux Foundation

The Linux Foundation is a non-profit in San Francisco. It mainly supports Linux, an important Open-Source project created by Linus Torvalds. The Foundation offers funding and helps to over 900 Open-Source projects, including Linux, cloud tools, blockchain, AI, machine learning, and databases. It builds strong project communities and helps more people use Open-Source technology. The Foundation also hosts large events, such as the Linux Kernel Maintainer Summit and the Linux Plumbers Conference.

Apache Software Foundation

The Apache Software Foundation (ASF) is based in Delaware, USA, and supports many Open-Source projects like the Apache Web Server. The ASF is known for the 'Apache Way', where people gain

influence through their contributions. ASF supports more than 320 active projects and offers legal protection with the Apache Licence. ASF values 'Community Over Code,' believing a strong community is key to good code. ASF's founders include Brian Behlendorf, Ken Coar, Roy T. Fielding, and Jim Jagielski.

Mozilla Foundation

The Mozilla Foundation is a non-profit based in Mountain View, California. It works to keep the Internet a global public resource open to all. With leaders like Mitchell Baker, Mozilla works for the Open Web and supports Open-Source products, such as Firefox. Mozilla released the Firefox Browser to challenge Internet Explorer and stands for open web standards, privacy, and user control. The Foundation leads efforts to help the Internet grow by teaching digital skills and supporting education.

Creative Commons

Creative Commons (CC) helps people share creative works using easy Open Licences (such as CC BY and CC BY-SA). These licences, like Free Software licences, help people share knowledge and art for free.

Software Freedom Conservancy

Software Freedom Conservancy is a non-profit that provides legal and financial support to many Free, Libre, and Open-Source Software (FLOSS) projects. It lets software experts focus on their work rather than on legal or financial issues. If someone violates a Free Software licence, such as the GNU General Public Licence, the Conservancy helps pursue legal action to protect the community. It also works to inform the public about Free Software and users' rights, and push for policy changes. The Conservancy supports many important Free Software projects.

Free Software groups turned a technical idea into a social movement. They helped Free Software gain legal and social support. But these movements still face issues such as financial constraints, corporate pressure, and complex laws. Free Software and Open-Source groups are making a big impact around the world, including in countries like India, by bridging the digital divide and making technology fairer.

The Apache Way

The Apache Way is a set of practices that guide the Apache Software Foundation (ASF) and its projects. It is more than a technical process; it is a culture based on working together. One main part is meritocracy. This means a person's role depends on what they contribute to the project, such as the code they write or the help they provide to the community. Titles or friendships do not matter. According to 'Community Over Code,' the people who build the code are more important than the code itself. ASF believes a healthy group creates good code, but a weak group cannot. They value respect, open communication, and inclusion.

Another key part is 'Open and Transparent Development.' All talks, choices, and coding are done in public, so anyone can join or follow progress. Projects make their own rules instead of being run from the top. Each has a Project Management Committee (PMC). Big choices are made by the group agreeing, not just by voting. Every opinion matters. The Apache Licence allows anyone to use, change, or sell the code. The Apache Way, a set of principles used by the Free Software Foundation to build Open-Source projects, encourages collaboration and high-quality code.

Open Web

Open Web describes the basic idea of the Internet. The Open Web is a shared, open platform for everyone to use, where anyone can access, share, or talk online. It aims to operate under common rules rather than be run by a single group or company.

The main feature of the Open Web is its advocacy for Open Standards. This means that fundamental technologies such as HTML, HTTP, and JavaScript should not be monopolised by any single entity. It ensures that anyone can use them to build websites and develop applications. Furthermore, another key feature is the ability to access and share information from anywhere in the world, using any device, without any restrictions. The Open Web places great importance on individual privacy and data control. This approach empowers users to have more control over their digital lives.

The Open Web is essential for innovation, creativity, and freedom. It provides opportunities for even small enterprises to reach a global audience, for individuals to share their ideas with the world, and

for knowledge to be freely disseminated. The Open Web serves as a crucial platform for social and political discourse and digital democracy. However, corporate interests, data monopolies, and censorship threaten the existence of the Open Web. Overcoming these challenges and protecting the fundamental freedom of the Internet is a critical challenge in today's digital world. Today, the Open Web faces renewed challenges from algorithmic monopolies and proprietary social networks. The rise of federated systems, such as Mastodon and the ActivityPub protocol, reflects a growing resistance to centralised control and a return to the Internet's original, federated spirit.

From software freedom to open knowledge, these movements redefine technology as a shared inheritance, reminding us that innovation, when unchained from enclosure, becomes a collective act of liberation.

NOTES

Mitchell Baker is a prominent figure in the Open Web movement, the current Chairwoman of the Mozilla Foundation, and former CEO of the Mozilla Corporation. She is a well-known American figure who strongly advocates the freedom and openness of the Internet. Baker, who has a legal background, entered the Open-Source world while working in the legal department at Netscape Communications in the late 1990s. She played a critical role in leading Netscape's decision to Open-Source its browser code. Subsequently, she played a key role in founding the Mozilla Project and co-founded the Mozilla Foundation. Baker was one of the main drivers of Firefox's successful growth. Baker's philosophy, which emphasises user rights, privacy, and the public nature of the Internet, significantly influenced the formation of the "Mozilla Public Licence" (MPL). Mitchell Baker is a role model for increasing and inspiring women's representation in the technological world. Her efforts to maintain the Internet as a public resource and make it accessible to all have garnered global attention. Several publications, including *Forbes* magazine, have named her one of the most influential technologists globally.

CHAPTER FOURTEEN

Free Software, Open-Source, and Artificial Intelligence: The Roots of Future Technology

The rise of Artificial Intelligence (AI) marks one of the most transformative periods in the history of technology. Yet the intellectual roots that nourish today's AI revolution were laid decades earlier through the philosophies of Free Software and Open-Source, which emphasised transparency, democratic participation, and the unhindered circulation of knowledge. As AI begins to shape governance, healthcare, scientific research, culture, and even human cognition itself, questions of openness, accountability, and public control regain paramount importance. The Open-Source approach is crucial, on the one hand, for accelerating AI innovation and, on the other, for making AI technologies accessible to everyone.

What is Open-Source AI?

Simply put, Open-Source AI is the application of the principles of Open-Source Software to Artificial Intelligence. Open-Source AI ensures that anyone can study, use, modify, and share an AI model by making its core components publicly available. Like ordinary software, AI systems also have underlying code and licences. The goal of Open-Source AI is to ensure that this knowledge is not monopolised by a few corporations but is accessible to all. This enables developers and

researchers worldwide to participate equally in the development and application of AI technology.

The concept of 'openness' in AI requires defining four critical levels of transparency: 1) The model's source code (the algorithm logic); 2) The model weights (the learned "knowledge" of the system); 3) The training dataset (the corpus of information used to teach the model); and 4) The training methodology/architecture (the processes used to build the model). True Open-Source in the Free Software sense demands access to all four levels.

The Significance of Open-Source AI

The Open-Source approach makes significant contributions to the growth and spread of AI, offering numerous technological advantages and socially beneficial possibilities. When AI code and models are made available through open platforms, developers from around the world can collaborate. This accelerates development, paving the way for new inventions. Instead of a single team trying to solve a problem, progress is faster when thousands of people collaborate.

Cost Reduction and Accessibility are major features of Open-Source AI. Building and utilising large-scale AI models requires substantial financial investment. When Open-Source AI models and tools are available, small companies, startups, and individuals can utilise and develop AI technologies without incurring massive upfront investments. This helps bring the potential of AI to everyone.

Another advantage of Open-Source AI is the ability to avoid Vendor Lock-in—the reliance on specific private companies for AI services, which can be a major vulnerability. Users gain greater flexibility and choice. Open-source AI projects often have strong community support, which enhances their quality and ensures ongoing support for long-term sustainability. Since Open-Source code benefits from public auditing, security is comparatively better; with more people reviewing the code, security vulnerabilities can be quickly detected and resolved.

Major Open-Source AI Projects

Many of the most popular AI tools and models worldwide are Open-Source and have played a major role in advancing AI development. TensorFlow, an Open-Source library developed by Google, is widely used for building and training machine learning models. PyTorch,

a library developed by Facebook (Meta), is very popular among researchers. Hugging Face Transformers is a prominent platform for developing and sharing new AI models, including large language models. The Llama models released by Meta have had a significant impact on the development of new AI applications worldwide. These projects help make AI technologies accessible to everyone and accelerate innovation.

The New Landscape of Models, Licensing, and Control

The emergence of Large Language Models (LLMs), such as ChatGPT, has brought about significant changes. These models, capable of understanding and responding in human-like language, have provided a clear picture of AI's potential even to the public. However, most prominent models, such as OpenAI's ChatGPT, Google's Gemini, and Anthropic's Claude, are 'Closed Source' concerning their training data, architecture, and model weights. This means their method of operation is not fully accessible to the public. In contrast, models like Meta's Llama, Mistral AI, and the Falcon models are examples of 'Open-Source AI'. The code, architecture, and often even the training data for these models are publicly available.

AI has prompted the development of new licensing frameworks because traditional software licences were never designed to govern model weights or large-scale datasets. The emergence of licences such as the OpenRAIL family, the LLaMA Community Licence, and variations of Apache 2.0 augmented with model-specific clauses marks a significant evolution in the governance of AI.

A key distinction that has become central to contemporary discussions is that "open-weight" does not mean "Open-Source" in the philosophical sense. Many models described in public discourse as "open" release only their final model weights, while restricting access to the underlying training data or training scripts, making them only partially open according to Free Software principles. Maintaining this distinction is essential to clarity and public understanding of the level of freedom truly being offered.

Global Governance and Sustainability

The international policy environment surrounding AI is evolving rapidly. The European Union's AI Act distinguishes between Open-Source and proprietary systems and recognises transparency as a

cornerstone of AI governance. UNESCO's global ethical framework emphasises openness, fairness, and equity. Recent US Executive Orders highlight the need for transparency and risk assessment in AI development.

A major concern emerging from this policy landscape is AI Liability. Policy makers are grappling with whether liability for harmful outputs (e.g., medical errors, deepfakes) should fall on the original model developer (who released the open model) or the downstream deployer (the user who customised and deployed the application). This legal ambiguity is what drives the use of restrictive licences in the Open-Source community.

Environmental, Energy, and Hardware Costs of AI

Recent research has revealed that training cutting-edge AI models consumes extraordinarily high amounts of electrical energy and can require millions of litres of water for cooling. These environmental impacts vary significantly depending on training methods and data efficiency. Transparency becomes crucial here as well: without openness, society cannot evaluate the ecological footprint of AI systems.

Furthermore, while the software may be open, access to the necessary specialised computing hardware, particularly high-end NVIDIA GPUs, remains heavily monopolised. This hardware bottleneck acts as a *de facto* control mechanism, preventing smaller organisations and Global South entities from competing in training powerful foundational models, even if the software code is free. Closed models, by their nature, obscure information about energy usage and resource consumption, placing sustainability and corporate responsibility beyond public oversight.

While proprietary hardware remains a significant barrier to entry in the AI landscape, the growing Open-Source Hardware movement, which applies the principles of free software to physical design, offers a potential path toward technological independence. A primary example of this is RISC-V, an open-standard instruction set architecture (ISA) that allows researchers and smaller enterprises to design and build specialized processors for AI without being tied to a single vendor's proprietary technology. By moving toward open hardware designs for neural-accelerators and high-performance computing, the

Global South and independent innovators can begin to challenge the centralized control currently dictated by hardware monopolies.

The Safety vs. Openness Debate

A core philosophical tension in AI development centres on the debate between safety and openness. Proprietary firms often use "AI Safety" as a key justification for keeping their most powerful models closed, arguing that widespread distribution risks misuse for malicious purposes, such as spreading deepfakes or launching cyberattacks. However, Free Software proponents argue that closed models create "security through obscurity," preventing independent researchers from auditing the systems for catastrophic risks, inherent biases, or corporate ethical failures. This essential conflict highlights why access and transparency are vital for public safety, not detrimental to it.

The Ethical Imperative: Free Software Principles as the Antidote to the 'Black Box'

As AI technology progresses, the principles of Free Software are crucial for building systems that are more ethical, equitable, and transparent. The challenge of the "Black Box"—where the internal workings of a complex AI model are obscured, making its decision-making process impossible to understand or audit—is the ultimate ethical problem. This lack of transparency leads to a lack of trustworthiness, difficulty in detecting biases, and a lack of accountability when the AI makes a mistake.

The principles of Transparency and Auditability offered by Free Software provide the antidote to the Black Box. Open-Source AI models, by granting users and developers the ability to customise, control, and inspect the code, the methodology, and, ideally, the training data and model weights, ensure control over the technology by avoiding reliance on a single vendor. This convergence achieves accessibility and democratisation by making advanced AI technologies available to a broader global audience, reducing corporate dependence, and encouraging collective innovation.

India and the Global South: Open AI for Linguistic and Technological Freedom

India plays a significant role in the emerging open AI landscape. Initiatives like AI4Bharat and its Open-Source Indian-language

models, government-backed programmemes such as Bhashini, and indigenous open models demonstrate a commitment to linguistic and technological autonomy. Across the Global South, open AI is especially vital because proprietary systems often ignore low-resource languages and local contexts, thereby exacerbating technological marginalisation. The principles of Free Software thus become a means of resisting this marginalisation and ensuring that AI serves the needs of all linguistic and cultural communities.

The principles of Free Software and Open-Source will play a critical role in discussions about what AI should look like in the future, who should control it, and how its benefits should be distributed. The conflict between control and freedom determines who controls the tools of thought and creation in the information age.

The Future of Knowledge Freedom

This book began by examining how Intellectual Property Rights and the rise of software as a social and political artefact established the foundation of the Free Software movement. The main argument throughout has been that Free Software is not just a technical or niche concern, but a transformative philosophy shaping public policy, scientific collaboration, and democratic governance. Across the chapters, we explored modern IPR contradictions, global discourse shaped by historical struggles, TRIPS impacts, Open Science as a corrective, and the reclamation of the digital commons. These discussions collectively support the central claim: Free Software's ethos have profound, broad-reaching implications that challenge dominant systems and foster more equitable knowledge societies.

As demonstrated, the centralisation of digital power and expansion of proprietary control directly defines agency in the digital age. The core argument is that Free Software directly confronts these issues at their roots by demanding freedom to study, modify, improve, and share software. This principle remains vital as digital systems increasingly mediate all aspects of life. Evidence from this book shows digital enclosure mirrors wider societal inequalities, reinforcing the thesis that Free Software both critiques and practically addresses these injustices.

The discussions on Open Science and Creative Commons made clear that Free Software's principles powerfully extend beyond computing. The open-access movement, collaborative drug discovery,

and knowledge-sharing platforms all demonstrate the book's main argument: knowledge is most valuable when freely shared and stewarded collectively. These developments reinforce the core thesis that proprietary models cannot meet collective societal needs, and that transparency and shared stewardship are vital for equitable progress.

Significant challenges remain, as new forms of digital enclosure—algorithmic opacity, surveillance, and closed AI—threaten the progress open movements have achieved. The book's main argument is sharpened by showing that genuine freedom demands structural safeguards and enforceable rights, not just rhetoric. Free Software equips us with the understanding and tools needed to meet these contemporary challenges, reinforcing its broader philosophical relevance.

The future of software freedom cannot be assumed; it requires active commitment from a diverse set of actors. The historical analysis throughout the book underscores the main claim: knowledge freedom advances only through collective recognition and defense. Thus, Free Software's true contribution is its awakening of social consciousness on the importance of democratic technology design, directly aligning with the book's central argument.

Looking ahead, the philosophy of Free Software offers a clear and constructive model for a rapidly changing world, supporting the book's central argument that openness and collaboration are foundational to innovation and human progress. As digital realms expand, recommitting transparency and cooperation is essential, as the evidence presented demonstrates.

By embracing this vision, we reinforce the central argument: the digital world need not reflect scarcity or exclusion, but rather shared knowledge and collective stewardship. This is not only a technical stance but also the core moral and civic claim made throughout this book.

> *The struggle for software freedom is, ultimately, the struggle for societal freedom, the central argument underpinning this book, today and for future generations.*

NOTES

AI Model Weights is a key technical concept in Artificial Intelligence, particularly in Machine Learning and Deep Learning models, such as those used in neural networks. Weights represent the "knowledge or components" that an AI model has learned during its training. If we imagine teaching an AI model to distinguish between a cat and a dog when it sees a picture. The model will analyse many features, such as 'pointed ears,' 'whiskers,' 'fur,' and 'size,' to recognise the cat. The model decides on the 'importance' or 'strength' of each feature. This 'importance' or 'strength' is what is referred to as the 'Weight'. If 'pointed ears' are of high importance in recognising a cat, the weight assigned to that feature will be high.

More technically, weights are numerical values that determine the strength or importance of connections between layers and neurons (or nodes) in a neural network. When an input (for example, a picture's data) is fed into the model, these input values are multiplied by their respective weights. These multiplication results and other operations determine the model's output (for example, "This is a cat"). During the training phase, a large volume of data (millions of cat and dog images) is fed to the AI model. With each picture, the model's prediction is compared to the actual answer. If the prediction is incorrect, the model makes small adjustments to its weights to minimise the error the next time. This process is repeated millions of times using algorithms like "Backpropagation."

In summary, an AI model 'learns' through its weights. The patterns, relationships, and features that the model identifies from the training data are all recorded in these weights. A fully trained AI model is defined by its optimised weights and biases, which enable it to make accurate predictions or generate the required outputs when new data is received. Large and complex language AI models, such as ChatGPT, can have billions or even trillions of weights, making them incredibly powerful but also requiring massive computing resources to train and operate.

Black Box refers to a state in which the internal workings of an AI model or system—its decision-making methods and how it arrives at a particular conclusion—cannot be understood from the outside. Like being unable to open a black box to see what is happening inside,

in the case of these AI models, an input is given, and an output is received, but it is not possible to accurately explain how that output was generated.

It is particularly difficult to analyse how each of the billions of 'Weights' in complex AI models, such as deep learning, influences a decision. This lack of transparency leads to a lack of trustworthiness and difficulty in detecting biases; if there are any biases in the training data, the model may also make biased decisions. However, because it is a 'Black Box,' detecting and correcting this is challenging.

Furthermore, it creates a lack of accountability, as it is difficult to determine who is responsible when the AI makes a mistake. Because the model's working mechanism is unknown, finding and fixing security vulnerabilities can be challenging. This is why Free and Open-Source AI models are said to offer greater transparency: they lack the black-box nature, as everything, including the code and training methods, can be inspected.

ACRONYMS

1. Apache Software Foundation: ASF
2. Affero General Public Licence: AGPL
3. American Telephone and Telegraph Company: AT&T
4. Anti Counterfeit Trade Agreement: ACTA
5. Article Processing Charges: APCs
6. BioMed Central: BMC
7. Budapest Open Access Initiative: BOAI
8. Centre for Interdisciplinary Studies on Industrial and Economic Law: CEIDIE
9. CERN Open Hardware Licence: CERN OHL
10. Commission on Intellectual Property, Innovation and Public Health: CIPIH
11. Comprehensive and Progressive Agreement for Trans-Pacific Partnership: CPTPP
12. Continuous Integration/ Continuous Deployment: CI/CD
13. Council of Scientific and Industrial Research: CSIR
14. COVID-19 Technology Access Pool: C-TAP
15. Creative Commons: CC
16. Creative Commons Zero: CC0
17. Department of Science and Technology: DST
18. Digital Restrictions Management: DRM

19. Directory of Open Access Journals: DOAJ
20. DIY: Do It Yourself
21. Drugs for Neglected Diseases initiative: DNDi
22. ELSI: Ethical, Legal, and Social Implications
23. Free, Libre, and Open-Source Software: FLOSS
24. Free and Open-Source Software: FOSS
25. Free Software Foundation: FSF
26. General Agreement on Tariffs and Trade: GATT
27. General Agreement on Trade in Services: GATS
28. Geographic Information System: GIS
29. Geographical Indications: GI
30. GNU: GNU is Not Unix
31. GNU General Public Licence: GPL
32. GNU Free Documentation Licence: GFDL
33. GNU Lesser General Public Licence: LGPL
34. Human Genome Project: HGP
35. Humanitarian OpenStreetMap Team: HOT
36. Human T-Cell lymphotropic Virus: HTLV
37. Information and Library Network: INFLIBNET
38. Initiative For Open Innovation: IOI
39. Intellectual Property Rights: IPR
40. International Business Machines: IBM
41. International Federation of Library Associations and Institutions: IFLA
42. International Telecommunication Union: ITU
43. Large Language Models: LLMs
44. Massachusetts Institute of Technology: MIT
45. Medicines for Malaria Venture: MMV
46. Médecins Sans Frontières: MSF: Doctors Without Borders
47. Mozilla Public Licence: MPL
48. National Information System for Science and Technology: NISSAT
49. National Institutes of Health: NIH
50. National Knowledge Network: NKN
51. National Programmeme on Electronic Information Resources in Science & Technology: INFLIBNET
52. New England Journal of Medicine: NEJM
53. Open Access Scholarly Publishing Association: OASPA
54. Open Archives Initiative: OAI
55. Open Content Licence: OCL
56. Open Database Licence : ODbL
57. Open Educational Resources: OER

58. Oral Polio Vaccine: OPV
59. Open Society Foundations: OSF
60. Open-Source Drug Discovery: OSDD
61. Open-Source Initiative: OSI
62. Open-Source Malaria: OSM
63. Open-Source Mycetoma: MycetOS
64. Open-Source Pharma Foundation: OSPF
65. Open-Source Tuberculosis: OSTB
66. OpenStreetMap: OSM
67. OpenStreetMap Android: OsmAnd
68. OpenStreetMap Foundation: OSMF
69. Organisation for Economic Co-operation and Development: OECD
70. Polymer Chain Reaction: PCR
71. Public Library Of Science: PLOS
72. Scholarly Publishing and Academic Resources Coalition: SPARC
73. The SNP Consortium: TSC
74. Trade Related Aspects of Intellectual Property Rights: TRIPS
75. Traditional Knowledge: TK
76. Trans Pacific Partnership: TPP
77. United Nations Educational, Scientific and Cultural Organisation: UNESCO
78. World Intellectual Property Organisation: WIPO
79. World Trade Organisation: WTO
80. World Summit on the Information Society: WSIS

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INDEX

3D printers
128, 130

Aaron Swartz
47, 52–53, 79

AI Model Weights
152

Albert Bruce Sabin
117, 123

Alexandra Elbakyan
81, 85

Android
43

Apache Licence
43, 60–61, 141–142

Apache Software Foundation (ASF)
140–142

Apache Way
140, 142

Archive.org
78

Arch Linux
42

Artificial
10, 18, 37, 41, 44, 106, 112, 120, 125, 130, 135, 139, 145, 152

Artificial Intelligence (AI)
10, 37, 41, 44, 106, 112, 120, 125, 130, 135, 139, 145, 152

AT&T
38–39, 43

Bayer
23–24

Bell Labs
38, 45

Berlin Declaration
73–74

Bernardine Healy
101, 107

Bethesda Statement on Open Access Publishing
75

BioMed Central
77

Black Box
64, 149, 152–153

Bronze Open Access
70

Bruce Perens
63, 140

BSD licences
60–61

Budapest Open Access Initiative (BOAI)
73, 75

CERN Open Hardware
127

ChatGPT
147, 152

Christine Peterson
63

Cipla
23

Citation Index
68

Citizen Science
104–106

Claude
147

Cloud Computing
41, 44, 139

Coalition S
75–76

Compulsory Licensing
22–23, 28, 30

Copyleft
39–40, 44, 48, 56–57, 59–61, 64, 112, 140

Copyright
4–5, 9, 17–18, 34–35, 38–39, 44, 47–48, 50, 52, 59, 65, 68–70, 76, 84–86, 134

Corbevax vaccine
121, 124

Corporation
14, 22–23, 112, 143

Council of Scientific and Industrial Research (CSIR)
114–116, 125–126

Counterfeiting Trade Agreement (ACTA)
31–32, 77

COVID-19
21, 27, 36, 100, 117–122, 124, 128–129, 131, 134

COVID-19 Technology Access Pool (C-TAP)
122

Creative Commons
47–54, 70–71, 83, 89, 95, 112, 122, 127, 134, 141, 150

Data Exclusivity law
30

David Wiley
70–72, 83

DebianB
41

Dennis Ritchie
38, 45

Diamond Open Access
70, 76

Digital
10, 17–19, 34, 37, 44, 47, 51–53, 56, 58, 63, 65–66, 70–71, 74–75, 78–80, 82–85, 87, 91, 93–95, 101, 104, 115, 127, 130, 133–134, 136, 138, 140–143, 150–151

Digital Millennium Copyright Act (DMCA)
18
Digital Rights
18, 56
Digital Rights Management (DRM)
18, 140
Directory of Open Access Journals
77
Do It Yourself (DIY)
128, 131
Doha Declaration
28–29, 31, 35
Doha Flexibilities
28, 31
Double Dipping
69
Dr. Bernard Pacoul
123
Dr. Carlos Maria Correa
119, 124
Dr. Peter Hotez
121, 124
Dr. U.C.A. Jaleel
115, 118, 125
Dr. Vinod Scaria
115, 126
Dr. Zakir Thomas
115, 125
Drugs for Neglected Diseases initiative (DNDi)
117
eLife
77
Ethical, Legal and Social Implications (ELSI)
107
End-User Licence Agreements
18
Eric S. Raymond
63, 140
Evergreening
15, 20, 28, 30
Facebook
122, 135, 147
Falcon
147
Fedora
42
Free and Open Source Software (FOSS)
55, 63, 138
Free Libre and Open Source Software (FLOSS)
141
Free Software
1, 4–10, 13, 19, 33–35, 37–44, 46–49, 51–60, 63–65, 70–71, 74, 82–83, 87–88, 99, 106, 111, 113–114, 123, 127, 129–130, 133, 136–137, 139–142, 145–151
Free Software Foundation (FSF)
44, 55, 64, 140, 142
Free Trade Agreements (FTA / FTAs)
29–36
Frivolous Patenting
16
General Agreement on Tariffs and Trade (GATT)
25, 34
General Agreement on Trade in Service (GATS)
25–26, 34
General Public Licence (GPL)
35, 40–41, 48–49, 56–57, 59–61, 64, 70, 83, 121, 140–141

Generic drugs
20–21, 28, 30–31, 111

Geographical Indications (GI)
2, 7, 10

GeoLadies
136–137

GNU
35, 37, 39–41, 43–44, 46, 48, 56, 59, 64, 83, 89, 103, 121, 140–141

GNU Free Documentation Licence (GFDL)
89, 140

GNU General Public Licence (GPL)
35, 40–41, 48–49, 56–57, 59–61, 64, 70, 83, 121, 140–141

GNU Octave
103

Golden Open Access
69

Green Open Access
69

Global Health Drug Discovery Institute (GHDDI)
117

Global Virus Network (GVN)
119

Harold Varmus
77

Hindawi
77

Human Genome Project (HGP)
100–102, 106–109

Humanitarian OpenStreetMap Team (HOT)
134–137

Howard G. Cunningham
88, 95

Hybrid Open Access
69

Impact Factor
68

Indian Patent Act
21, 26

Industrial designs
6, 9–10, 34

Information and Library Network
80–81

Initiative for Open
116

Innovation
3, 10, 15, 17–19, 25, 34, 42, 44, 56–58, 75, 84, 88, 111, 114, 116–117, 120, 122–125, 128, 130–131, 142–143, 145, 147, 149, 151

Intellectual Property (IP)
1, 3–4, 7–10, 13–14, 17, 21, 25–26, 28–29, 32–35, 47, 52, 63, 75, 85, 102, 106, 116, 119, 121, 124–125, 129, 150

Intellectual Property Rights (IPR)
1–4, 7–10, 13–14, 17, 21, 25–26, 28–29, 33–34, 75, 85, 116, 121, 150

Intelligence
10, 37, 41, 44, 95, 106, 112, 120, 125, 130, 134–135, 137, 139, 145, 152

Internet
31–32, 41, 44, 47, 52, 73–74, 78–79, 87, 89, 96, 141–143

Internet Archive
78–79

Large Language Models (LLMs)
147

Linux Foundation
45, 140

Linux Kernel
40–43, 45–46, 140

Linux Mint
42

Massachusetts Institute of Technology (MIT)
37–38, 44, 46, 53, 57, 60–61, 63, 71, 84, 140

Medicines for Malaria Venture (MMV)
113, 123

Medicines Patent Pool (MPP)
117, 122

New England Journal of Medicine (NEJM)
77

Open Archives Initiative (OAI)
66

Open Database Licence (ODbL)
133–134

Open Educational Resources (OER)
50, 71–73, 79, 83, 100

Open Publication Licence (OPL)
70, 83

Open-Source Drug Discovery (OSDD)
22, 111–116, 120

Open-Source Initiative (OSI)
56, 64, 140

OpenStreetMap (OSM)
117–118, 133–138

OpenStreetMap Foundation (OSMF)
136–137

Polymerase Chain Reaction (PCR)
14, 22, 112, 120

Public Library of Science (PLOS)
76–78, 101

Structural Genomics Consortium (SGC)
116

Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS Agreement)
10, 21, 26–31, 33–35, 119

United Nations Educational, Scientific, and Cultural Organisation (UNESCO)
50, 72, 76, 99, 106, 148

World Intellectual Property Organisation (WIPO)
9, 32, 34–35

World Trade Organisation (WTO)
10, 21, 25, 26, 28, 30–34, 119

Z-Library
81, 84–85

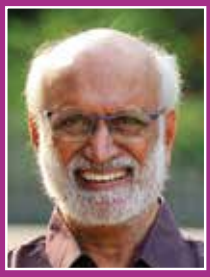
Zotero
102–103

FREE SOFTWARE
Philosophy

CONCEPTS AND APPLICATIONS

FREEDOM, COOPERATION AND SHARING

Dr. B. Ekbal



A DEFINITIVE GUIDE TO THE PRINCIPLES AND PRACTICES OF FREE SOFTWARE

Free Software represents an ongoing chronicle of human creativity, collaboration, and resistance to enclosure. This book offers a powerful journey through the philosophies and struggles that shaped the Free Software movement, its roots in hacker culture, its battles with proprietary software giants, and its profound impact on innovation, scientific discovery, and democratic access to knowledge.

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A timely reflection for an age shaped by algorithms and corporate power, this book is a call to imagine a future in which technology serves the public good and knowledge remains truly free.

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